Multimedia system model for electrical circuits on android mobile devices

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Abstract. This article aims to design the multimedia system application model of electrical circuits to make it easier for everyone to learn and understand electrical circuits in support of completing the required electrical circuit learning practice activities. The learning material models are designed interactively, which includes basic knowledge about electrical circuits and electrical circuit simulations. The Multimedia Development Life Cycle (MDLC) method is used for the design of this multimedia system. The design phase consists of 6 stages, namely, concept, design, material collecting, assembly, testing, and distribution. The results of the study are the multimedia system application of electrical circuit that mainly can be applied on Android-based mobile devices.

1. Introduction
The development of technology has supported humans to improve the quality of their lives. One of which is information technology [1]. The use of information technology through smartphones continues to increase. This can be seen from smartphone users in Indonesia experiencing a rapid increase, which according to research conducted by the Indonesian Internet Service Providers Association in 2017 smartphone users in Indonesia reached 50.08% based on the total population [2]. The use of Android-based smartphones is now not limited to supporting public services or business but has been widely used to support educational activities [3,4]. One of the utilization of smartphones for education activities is the number of making learning media applications based on Android smartphones that can help students in the learning process at school [5].

Several previous studies have discussed various topics of discussion of application development based on learning media including physics learning media applications for 7th-grade students based on Android [6], multimedia and Android-based culinary applications [7], interactive media learning for mathematical [8,9], chemistry learning media [10], and physics interactive learning media [11]. The approach method used in the development of instructional media by previous researchers generally uses the approach of the Multimedia Development Life Cycle [12].

One of the purposes of writing this article is how to create the multimedia system application model for electrical circuits to make it easier for everyone to learn and understand Electric circuits, to complete the learning activities of the essential practice of electrical circuits. In the primary school curriculum in Indonesia, the basic material of this electrical circuit is conveyed to elementary students in Natural Sciences but limited to theory without practice. Therefore, to facilitate students in understanding the basic electrical circuits, an Android-based electric circuit learning media application...
will be made. The method used for application development uses the Multimedia Development Life Cycle. The presentation of learning material designed interactively includes basic knowledge of electrical circuits and electrical circuit simulations. The expected result in this work is the success of designing and building an Android-based electric learning circuit media application that can be used by everyone and elementary students to support their learning activities.

2. Methods
The method used in completing the manufacture of multimedia system model applications for electrical circuits is to use the approach of Multimedia Development Life Cycle (MDLC) [12].

![Figure 1. Activity workflow based on MDLC method.](image)

In figure 1, workflow activities are based on the adoption of the MDLC method, along with the steps in developing multimedia system applications for electrical circuits. Still, the six activities do not have to be sequential in practice, and they can exchange positions. Even so, the concept stage must indeed be the first thing to do. Further details will be discussed in the results and discussion section.

3. Result and discussion

3.1. Result
The results of the study are closely related to the research question, namely how to design a basic application of an Android-based electrical circuit that displays information related to a simple electrical circuit and its simulations. To develop the application of electrical circuits, several activities are carried out by MDLC method, namely:

3.1.1. Concept. At this stage, specify the identification and objective of the multimedia application as in table 1. Basic design rules are also specified in conceptualizations, such as the size and target of the application. Other efforts, such as estimated costs, time, resources, and implementation targets, must also be considered if needed [13,14]. Based on the purpose of this study, the results obtained regarding the functional requirements of the application to be made are to provide simulations about simple electrical circuits.

| Concept       | Explanation                                           |
|---------------|-------------------------------------------------------|
| Title         | Multimedia system for learning electrical circuits    |
| Users         | For mobile users and elementary students              |
| Images        | The images used are in jpg and png format             |
| Music and sound| WAV and MP3 format                                    |
| Interactive   | Interactive on the application can be found on the simulation menu |
3.1.2. Design. At this stage, there are two main steps, namely storyboard design and navigation structure, for the navigation structure follows the sequence in the storyboard design. The storyboard is a sketch of images created in a structured way to make it easier to design applications that are developed. In making an application, storyboard design is needed, which is divided into several scenes, which will be presented in table 2.

Table 2. Storyboard description.

| Scene     | Explanation                                                                 |
|-----------|-----------------------------------------------------------------------------|
| Home      | Page to display logo                                                        |
| Menu      | Menu pages; knowledge material, animated videos, simulations, and instructions |
| Knowledge | Knowledge material page contains a short knowledge about electrical circuit   |
| Animation | Animation page, showing animated Series and Parallel Electric Circuits.       |
| Simulation| The simulation page, which displays electrical circuit simulations namely, series |
|           | simulations and parallel simulations                                         |
| Series Page| Simulation page of series electrical circuits                                |
| Parallel Page| Simulation page of parallel electrical circuits                             |
| Help      | Help instructions usage page                                                |

3.1.3. Material collecting. There are three primary materials for developing an electric circuit learning media application, namely images, animation, music, and sound. For images used in JPG and PNG format, then for music and sound using WAV and MP3 formats. The material was made first because it was needed to develop the application of learning media for electrical circuits to be more exciting and interactive.

3.1.4. Assembly. This stage is the making of an application where all data materials such as images, sounds, and animations are combined using Adobe Flash CS6 software and arranged according to the design of the storyboard after that given an action script so that all functions can run properly. The following is part of the display interface that results from the implementation of making an electric circuit learning media application.

![Figure 2. The main menu interface and help instructions usage page.](image)

![Figure 3. Simulation of electrical circuits in series.](image)
3.1.5. Testing. The testing step executes after the phase of assembly is finished using alpha testing techniques [15]. Based on the results of tests that have been carried out on the electric circuit learning media application, it generates the conclusion that all application functionality has been running and functioning correctly on smartphone devices based on the Android Operating System.

3.1.6. Distribution. At the distribution stage, applications that have passed alpha testing will be stored in storage with an Android package (*.apk) file format that is ready to be installed and used by Android smartphone users.

3.2. Discussion
This research resulted in the application of android-based multimedia learning system for electrical circuits, with the hope of helping the community to learn on their own about electrical circuits, especially elementary students. This research was conducted based on the gaps of some work from making previous learning media but with a different topic, where the output application generally is only in the form of learning material with animation without the existence of interactive simulation elements.

Whereas in the current work in the form of electrical circuit learning media that is presented with animations and equipped with interactive simulations, the hope is to attract users' interest to learn as some previous researchers have done [9–11,16]. This electric circuit learning media application has two main features namely, first the animation feature that displays the electrical circuit knowledge that is presented with animation and secondly the simulation features as an evaluation/practice material, so that users can compile a series of electrical circuits and parallel electric circuits on their smartphone. With this learning media application, it is expected to be able to attract people's interest in learning, primarily elementary students independently and in class with the use of Android-based smartphone technology.

4. Conclusion
The application of the electrical circuit multimedia system model that is designed presents a simulation feature that can be used as an alternative tool to replace the real activities of testing series electrical circuits and simple parallel circuits. Simulation animation feature on multimedia system of electrical circuits is expected to help understand and learn by themselves about the electrical circuit without having to prepare the actual equipment.

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