Resistance Calculator Application based on Android

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Abstract

This research aims to 1) develop an android application for calculating resistance on Android, 2) perform the performance test on the system and 3) gather user opinion towards the application. The target users in this research are the application downloaders from the Google Play Store. Research tools are including the application developed for calculating resistance on Android, quality assessment by experts and the comments of the sample users. The statistics used in the research are percentage, mean and standard deviation.

As a result of the research, 1) the application for calculating resistance on Android is published on the Google Play Store, 2) the application performance is evaluated by three experts which is at the highest level (mean = 4.53, standard deviation = 0.47) and 3) the application is rated at the highest score with 73.17 out of forty-one users.

Key word: *resistor, resistance computation, android application*

1. Introduction

In 2009, the department of computer technology was established. A number of high school graduates have been brought into this undergraduate-level study. Within the department, they are taught about both computer hardware and software. Since the new students have been educated in many different standards, they do not have the same basic computer knowledge, especially computer hardware. One of the problems they found is that they are unable to read the resistance value of a resistor. This problem is not only found in computer technology students but can also be found in most of people in the world. This is because we need to remember the color code and the position on a resistor in order to read and calculate the resistance value correctly [1].

Resistors [2‑8] are a tool which resist or reduce the flow of an electric current in order to control electric voltage and current within a circuit. A resistor reduces an electric current by turning electrical energy into heat and release into the environment, respectively. Since each device and tool within a circuit is designed to operate in different values of voltage and current, resistors become one of a crucial part within an electronic circuit. Nowadays, there are several types of resistors which can be divided, based on resistance value, into three types, including fixed, adjustable, and variable resistors. The size of a resistor typically shows the power rating (Watts) of the resistor. On the other hand, the resistance value (Ohms, Ω) can be calculated from the color bands across the resistor. Generally, the resistor color code consists of four to five color bands (as shown in Figure 1.)
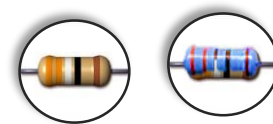

Figure 1: 4‑band and 5‑band Resistors

The resistance can be read from the color bands. The first two bands of a 4‑band resistor and the first three bands of a 5‑band resistor tell the base resistance value by replacing number zero to nine with a color code including black, brown, red, orange, yellow,

green, blue, violet, grey, and white, respectively. The next band (3rd of 4-band, 4th of 5-band) is a multiplier. The first two or three digits are multiplied by 1, 10, 100, 1,000, 10,000, 100,000, 1,000,000, 0.1, or 0.01 depended on the color of this band which includes black, brown, red, orange, yellow, green, blue, gold, and silver, respectively. The last band is tolerance rate of the resistor, in other words, percentage of resistor precision. This band colors consist of brown, red, gold and silver which can be translated into 1%, 2%, 5% and 10%. The color bands can be translated as shown in Figure 2.

Figure 2 demonstrates the resistance calculation for both 4‑band and 5‑band resistors. According to the above mentioned color band translation, the above 4-band resistor has the resistance rate of 47,000 Ohms with the resistance tolerance of 5%. This means the resistor has a resistance value between 44,650 to 49,350 Ohms. As for the 5-band resistor in Figure 2, it has a resistance value of 51,000 ± 1% Ohms which operates between 50,490 to 51,510 Ohms.
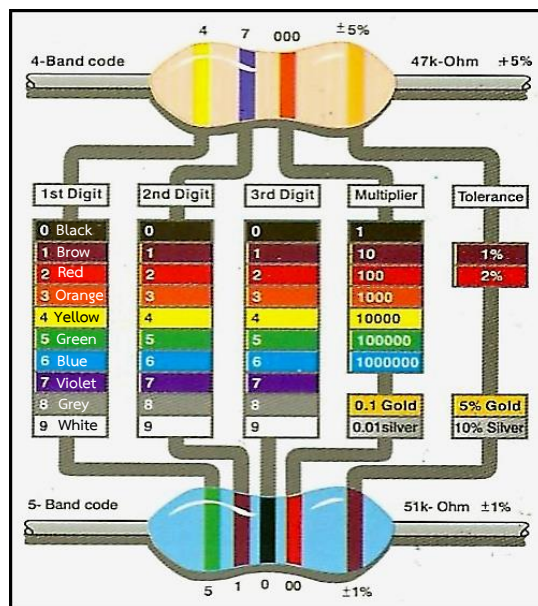

Figure 2: resistor color code

Source: http://cs4hs.cs.pub.ro

In the past few decades, the smartphone technology have been developed and improved into the state that it is hard to live without one. Digital Advertising Association (Thailand), also known as DAAT, and MarketingOops.com make a survey for Thai people behavior on the Internet access through smartphone and found that 38 million out of 68.1 million populations are the Internet users [10]. In recent years, there are two well-known and most popular smartphone operating systems, including Google Android and Apple IOS. However, from statistics, application developers prefer Android over IOS. In 2018, the number of Android application available in Google Play Store is raised into 3,638,108 applications [9]. Since Android is an open source operating system, it is simple to find the source code and make a change. Google allows developer to access the most crucial parts of the operating system which allows further development and makes Android even better. The developer could reduce the development cost from the license exemption. Moreover, there is a lot of available hardware compatible with Android.

According to the above mentioned issues, in this paper, we propose an Android application which is capable of calculating resistance value out of 4-band and 5-band resistors. This application is developed in order to help generic users to conveniently calculate the resistance value and reduce the error of the reading.

2. Research Methodologies

From our study, we found that reading resistance value from a resistor with the resistor color code requires the knowledge how to translate calculate the color bands. Color code readers need to remember the meaning of each color along with its position. Otherwise, they need to compare each color band with the color code table for each position of the band. Furthermore, the color readings are different depended on types of resistors, for example, 4-band and 5‑band resistors. In the case of 4‑band resistors, the first and the second bands represent a 2‑digit multiplicand while the third band serves as a multiplier. Finally, the last band shows the precision of the resistor. In terms of 5‑band resistors, the meaning of each band is similar except the third band becomes the third digit of the multiplicand. Accordingly, the operation structure can be expressed as shown in Figure 3.
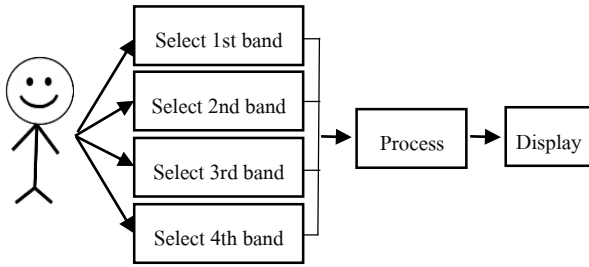
Figure 3: system operation structure

In the application design and development, we choose the Android Studio and Java as a development tool and language. Since both of them are open software, they can be used for free. The Android Studio is released by Google for Android application developers. Java is developed by Sun Microsystems and now is owned by Oracle Corporation. Based on these two software, our system operation is designed as shown in Figure 4.
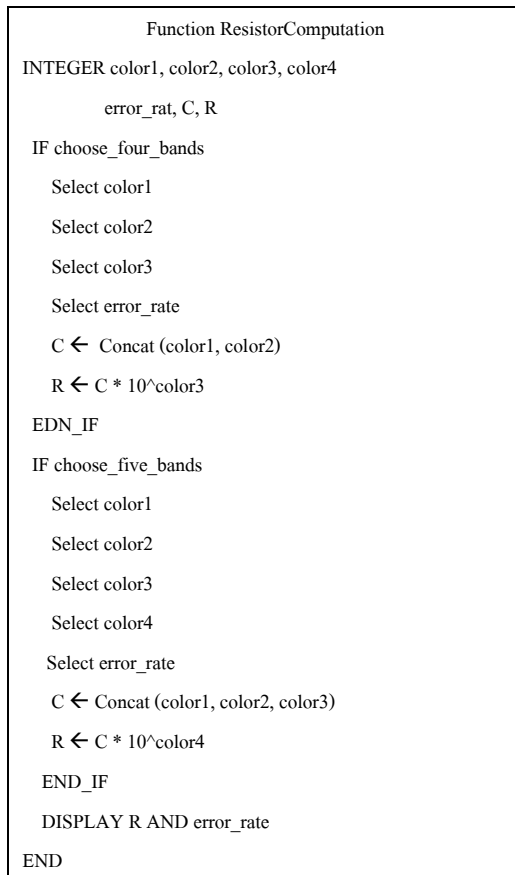
```
Function ResistorComputation
INTEGER color1, color2, color3, color4
          error_rat, C, R
IF choose_four_bands
   Select color1
   Select color2
   Select color3
   Select error_rate
   C ← Concat (color1, color2)
   R ← C * 10^color3
EDN_IF
IF choose_five_bands
   Select color1
   Select color2
   Select color3
   Select color4
   Select error_rate
   C ← Concat (color1, color2, color3)
   R ← C * 10^color4
 END_IF
 DISPLAY R AND error_rate
END
```

Figure 4: system operation

From Figure 4, an application user first has to select the type of the target resistor whether it is a 4-band or 5-band resistors. If the 4-band resistor is selected, the user can select four colors for four color band start from left-hand side. Then, the resistance calculation function proceeds the process by:

1) concatenating the first and the second bands, then, store the result in the variable C with the command $C \leftarrow$ Concat (color1, color2);

2) calculating a resistance value and store the result in variable R using the command $R \leftarrow C * 10^{color3}$;

3) finally, the application displays the result stored in R and the last color band as an error rate on the smartphone screen.

The application proceeds in similar manner, if the user selects 5-band resistor.

In terms of system testing and analysis, the black box method [11] has used for the sake of accurate results. The testing and analysis process is divided into two procedures including:

1) a system testing, performed by the researchers, which mainly focus on the application functionality to determine whether it meets all requirements according to the design;

2) a system testing, performed by three experts, which is an overall testing.

Then, after the testing from both parties, we upload the application onto the Google Play Store so that students and other Android users could download it. We also collect the satisfaction rating and reviews for future development.
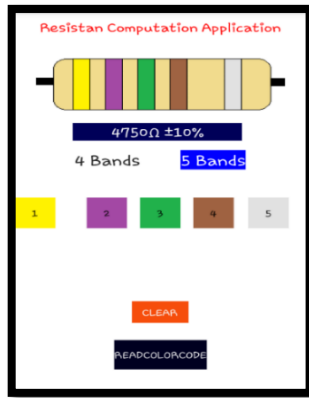
3. Research Results

In this research, we design and develop a resistance calculator application based on Android smartphone. Our application is as shown in Figure 5.
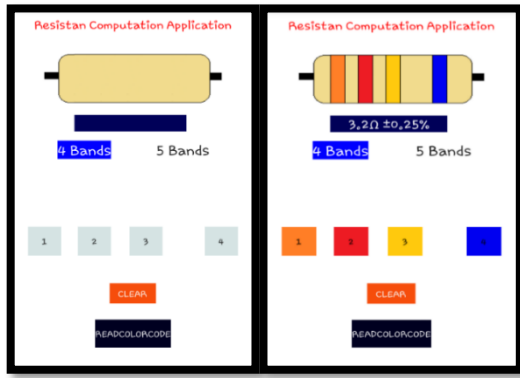
(A) first page   (B) 4-band calculation

(C) 5-band calculation

Figure 5: application interface

Figure 5 (A) is the homepage of the application. The type of the designated resistor can be selected from this page. Users can choose either 4-band or 5-band resistors for further calculation. If the 4-band resistor is selected, the color selection page (as shown in Figure 5 (B)) will be displayed. Otherwise, the color selection page for 5-band resistor, as shown in Figure 5 (C), will appear. The user only need to fill in the color of each band for either 4-band or 5-band resistor, then, click on READCOlORCORE button. After that, the application instantly calculate the resistance value and the resistance error rate. In order to read a new resistor, the user can proceed by push the CLEAR button.

In order to evaluate the performance of the application, a performance test has performed by three experts in computer design, application development, and electrical engineering. Then, the evaluation result is statistically calculating and analyze comparing with 5-level quality and quantity rating scale according to Likert [12]. The performance evaluation result is as shown in the following table.

Table 1: performance evaluation by experts

Evaluation	$\overline{x}$	S.D.	Result
1 .GUI design	4.33	0.47	High
2 .System operation	4.67	0.47	Very High
3 .Convenience of use	4.67	0.47	Very High
4 .System performance	4.33	0.47	High
5 .Application benefit	4.67	0.47	Very High
Total	**4.53**	**0.47**	**Very High**

In Table 1, the performance evaluation result from three experts shows that the application is rated in the highest rate (average of 4.53 and standard deviation of 0.47.) When we look further into each evaluation topic, the result is briefly as following:

1) GUI design is highly rated at average of 4.33 and standard deviation of 0.47

2) system operation is very highly rated at average of 4.67 and standard deviation of 0.47

3) convenience of use is very highly rated at average of 4.67 and standard deviation of 0.47

4) system performance is highly rated at average of 4.33 and standard deviation of 0.47

5) application benefit is very highly rated at average of 4.67 and standard deviation of 0.47

For the future access to the application, we upload the resistance calculator application onto the Google Play Store so that students or any other Android users can download, use, rate, and review this application [13]. Users can rate the application in five ratings from the highest score of 5 to the lowest score of 1. In Figure 6, there are in total 41 users who download the application. Out of the 41 people, the application is rated with score of 5 by 30 people, score of 4 by 7 people, score of 3 by 2 people, and score of 2 by 2 people. The above

mentioned result indicates that most of the users are satisfied with the application. There are approximately 73.17% out of 41 users rate the application by the score of 5.
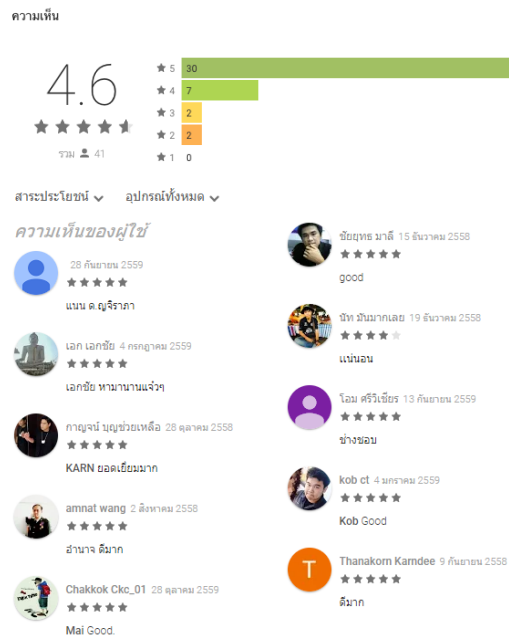

Figure 6: application rating and user reviews

4. Discussions

The Android-based resistance calculator application is able to accurately calculate the resistance value of any 4-band and 5-band resistors. A user only needs to select the type and bands' color of a resistor. The application can tell both resistance value and the resistance error rate.

The application can perform well according to the satisfaction result from experts which is in the highest level with average of 4.53 and standard deviation of 0.47. This reflects that our application have what it takes to support the users in terms of convenience of use, simplicity, and functionality. Furthermore, the application have got the highest user satisfaction score which is 5 from 73.17% out of 41 downloaded users. This indicates that the application satisfies user needs including simplicity of use and accurate calculation functions.

5. Conclusions

The developed application allows users to conveniently calculate the resistance value of a resistor. Users can easily download the application from Google Play Store into their Android-based smartphone for free.

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