Chapter 30
Android Application for Distribution Switchboard Design

Julius Sentosa Setiadji, Kevin Budihargono and Petrus Santoso

Abstract Mobile applications for distribution switchboard design are very rare. Currently, existing program is a program on a PC that can be used to perform complex electrical switchboard design but is not considered practical. An Android application is proposed to be used design a distribution switchboard in a practical way. The application is designed for 10.1" tablet platform with API 16 android operating system. This application was developed by using "Eclipse" software. Distribution switchboard designed follows the standard PUIL, SPLN, IEC, and IEEE. Distribution switchboard that has been designed by this application can be compared to the result of "MyEcodial L 3.4" software.

Keywords Distribution switchboard · Electrical switchboard design · Mobile application

30.1 Introduction

Mobile Application has the potential to grow very rapidly. This is because mobile phones (smart phones) have a crucial role, namely in the fields of communication, information, mobility, and entertainment. On the other hand, the use of mobile applications to support hobby and engineering application are still very underdeveloped [1]. It is very possible to use mobile applications to support the work in the field of engineering.

The development of mobile applications in the electrical power engineering sector is still very minimal. In the other hand, there is PC version program that can be used to perform complex electrical switchboard design but it is considered as not practical.

J.S. Setiadji (✉) · K. Budihargono · P. Santoso
Electrical Engineering Department, Petra Christian University,
121-131 Siwalankerto Street, Surabaya, Indonesia
e-mail: julius@petra.ac.id

P. Santoso
e-mail: petrus@petra.ac.id

With the need to design electrical switchboards rapidly and mobile in the workplace, it is become necessary to develop mobile applications in the field of electricity, especially in the electrical switchboard design that is simple yet compact so that the electrical switchboard design can be done easily and flexibly.

This application is designed the tablet platform size of 10.1" with android operating system API 16. This application is developed by using "Eclipse" software. Electrical switchboard that can be designed Distribution Switchboards follows the standard PUIL, SPLN, IEC, and IEEE. Electrical switchboard that has been designed by this application will be compared or "MyEcodial L 3.4" software.

30.2 Electrical Switchboard

Electrical switchboard is an arrangement of electrical components arranged in a control board so those components interrelated and form functions as needed [2].

Distribution switchboard is an electrical switchboard which serves to maintain the availability of electrical power by performing the function of insulating electrical faults [2]. Distribution switchboard design covers the placement of the following components: circuit breaker, busbar and cable. Nominal current rating of circuit breaker can be determined by using formula [3]:

$$P_{3\Phi} = \sqrt{3} \times V_{\Phi-\Phi} \times I \times \cos\varphi \qquad (30.1)$$

where, I is current (A), $P_{3\Phi}$ is 3-phase active power (W), $V_{\Phi-\Phi}$ is line to line voltage (V), $\cos\varphi$ is load power factor.

Breaking capacity of circuit breaker can be determined by using formula [4]:

$$I_{sc} = \frac{V_{\Phi-\Phi}/\sqrt{3}}{Z_{sc}} \qquad (30.2)$$

where, I_{sc} is short circuit current (A), $V_{\Phi-\Phi}$ is line to line voltage (V), Z_{sc} is $\sqrt{\left(\sum R\right)^2 + \left(\sum X\right)^2}$ (mΩ), $\sum R$ is sum of resistance (series) (mΩ), $\sum X$ is sum of reactance (series) (mΩ).

30.3 System Design and Implementation

The developed application has a function to perform calculation to design a distribution switchboard. Distribution switchboard that has been designed by this application can be saved. That has been done so that data can be loaded and used as guidelines for the manufacturing of electrical switchboard as well as bidding references.

30.3.1   Database Design

In this application, the usage of database has two functions, namely to call component availability and to save the electrical switchboard design process. Component availability database include the availability of the following components: transformers, circuit breakers, cables, and busbars.

30.3.2   Interface Design

This application interface design consists multiple pages as follows:

- Electrical switchboard selection page
  This page accomodate user to select which electrical switchboard will be designed. This page contains ImageViews to inform the user which distribution switchboard they will design and buttons to accommodate the user to choose an electrical switchboard to design (Fig. 30.1).

- Distribution switchboard section
  This section will be split into 3 input pages (see Fig. 30.2a, b and c) to accomodate the user to enter the data and 1 result page (see Fig. 30.2d).

   The input pages contain ImageViews and TextViews to inform the user what data they should enter, EditTexts and Spinners to accomodate the user to enter the data, and buttons to accomodate user to go to the next page.
   The result page contains ImageViews to display single line diagram of the designed distribution switchboard and TextViews to display the specification of the components that construct the distribution switchboard.

30.3.3   System Implementation

Implementation of the system can be summarized in a few process as follows:

- Electrical Switchboard Selection: when application is opened, user will be asked to choose which electrical switchboard to design.
- Distribution switchboard design: if user choose to design a distribution switchboard, user will be asked to input data as follow:

  (a) Transformer data that includes transformer apparent power, transformer impedance, load losses and transformer secondary voltage.
  (b) Cable between transformer and LV-MDP (Low Voltage—Main Distribution Panel) data that includes cable length, cable safety factor and cable placing.

Fig. 30.1 The design of the electrical switchboard selection page interface

(c) LV-MDP data that includes LV-MDP busbar safety factor, LV-MDP busbar type, system power factor and number of SDP.

(d) SDP data that include cable length between LV-MDP and SDP, SDP busbar safety factor, SDP busbar type and number of grouping each SDP.

(e) Grouping data that include load phase and load active power.

Based on formula, application will calculate the specification of the following components: cable between transformer and LV-MDP, LV-MDP circuit breaker, LV-MDP busbar, circuit breaker outgoing LV-MDP to SDP, cable between LV-MDP and SDP, SDP circuit breaker, SDP busbar, grouping circuit breaker. Standards used in this application are:

(a) Short circuit current calculation using IEC 60909

(b) Transformer database using SPLN 50/82

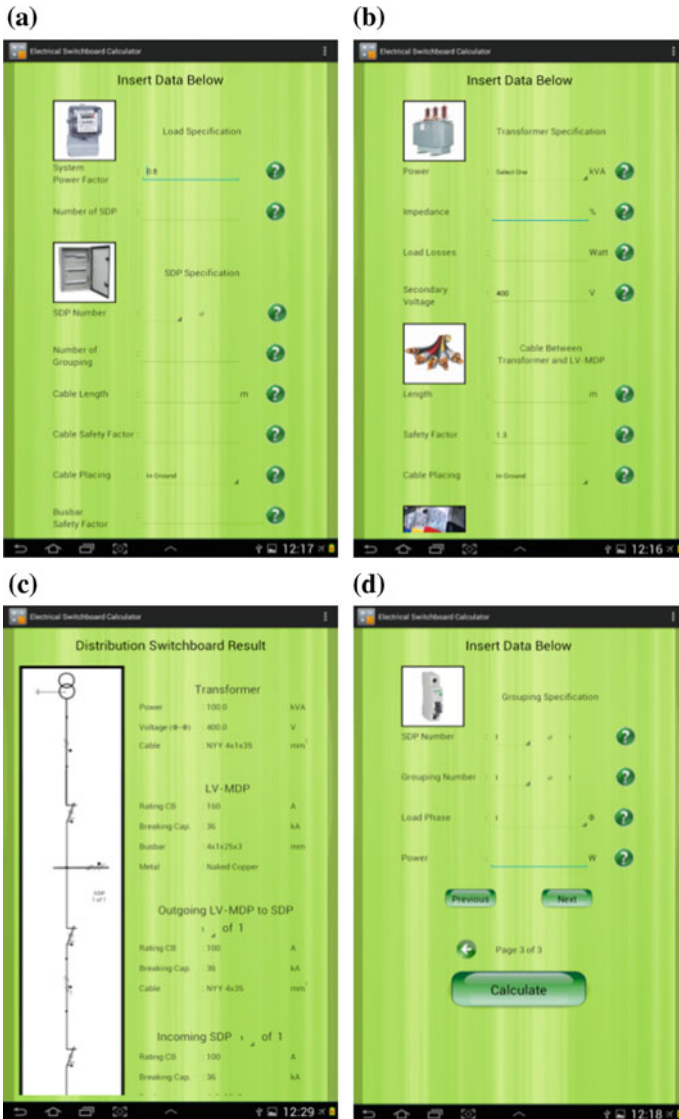(c) Cable database using SNI 04-0225-2000—Persyaratan Umum Instalasi listrik 2000 (PUIL 2000, in Bahasa Indonesia)

Fig. 30.2 The design of the distribution switchboard, **a** to input transformer, cable and busbar data, **b** to input SDP (Sub Distribution Panel) and load data, **c** to input grouping data, **d** to display result page

(d) Calculation of circuit breaker with breaking capacity 4.5 kA using IEC 60898-1

(e) Calculation of circuit breaker with breaking capacity over 4.5 kA using IEC 60947-2

(f) Capacitor database using IEC 60831-1/-2
(g) Capacitor bank's per step circuit breaker calculation using IEC 60831-1 and
     IEC 60931-1

30.4 System Testing

30.4.1 Database Testing

Database testing is performed by pulling the database from android and open the
database using "SQLiteBrowser" application. Database testing is performed to
ensure all component availability table has been successfully created entirely. The
test result can be seen in the following figure (Figs. 30.3 and 30.4).

Fig. 30.3 Database transformer availability (in Bahasa Indonesia)

	daya	impedansi	rugitembaga
	Filter	Filter	Filter
1	Select One		
2	25	4	680
3	50	4	1100
4	100	4	1750
5	160	4	2350
6	200	4	2850
7	250	4	3250
8	315	4	3900
9	400	4	4000
10	500	4	5500
11	630	4	6500
12	800	4.5	10200
13	1000	5	12100
14	1250	5.5	15000
15	1600	6	18100

Table: tabeltrafo

Fig. 30.4 Electrical switchboard selection page

30.4.2 Interface Testing

Interface testing is performed by displaying the interface that has been created using Samsung Galaxy Table 30.1 (10.1"). Interface testing is performed to determine whether the interface runs well on Android or not.

Table 30.1 Examples of calculation results table

Discription	Calculated with this application	Calculated with "MyEcodial L 3.4"
Rating circuit breaker LV-MDP	160 A	160 A
Breaking capacity circuit breaker LV-MDP	36 kA	25 kA
Arus *short circuit* LV-MDP	3, 286 kA	3, 31 kA
Main Busbar LV-MDP	$4 \times 1 \times 25 \times 3$ mm	$4 \times 1 \times 15 \times 5$ mm
Rating circuit breaker outgoing SDP	100 A	125 A
Breaking capacity circuit breaker outgoing SDP	36 kA	36 kA

30.4.3   Design Result Testing

Design result testing is performed by comparing the design result by application with "MyEcodial L 3.4" software. Design result testing is performed to verify distribution switchboard designed by this application.

The difference in form of circuit breaker specification occurred because of differences in the usage of circuit breaker database between this application and "MyEcodial L 3.4" software, different ways of calculating the requisite of circuit breaker nominal current rating and the application does not perform design with cascading system. These differences can be tolerated because they both meet the applicable standards.

30.5   Conclusion

The conclusion that can be drawn is as follows:

- The user is able to perform computerized process of designing distribution switchboards with this application.
- There were some differences in the design result using this application with the design result by "MyEcodial L 3.4" software. The differences are in the form of the short circuit current calculation and circuit breaker specifications.

References

1. Plaza, I., Martin, L., Martin, S., Medrano, C.: Mobile applications in an aging society: status and trends. J. Syst. Softw **84**(11), 1977–1988 (2011)
2. Schneider Electric Indonesia: Panduan Aplikasi Teknis, (in Bahasa Indonesia) (2010)
3. ABB: Technical Application Papers No. 8: Power Factor Correction and Harmonic. ABB SACE, Bergamo (2010)
4. De Mets-Nobalt, B., Dumas, F., Poulain, C.: Cahier technique no. 158—Calculation of short-circuit currents. Schneider Electric, Grenoble (2005)