Design and Implement an Application for Determination of Blood Chemistry

Ima Kurniastuti
Information System Department
Engineering Faculty
Nahdlatul Ulama Surabaya University
Surabaya, Indonesia
ima.kurniastuti@unusa.ac.id

Tri Deviasari Wulan
Information System Department
Engineering Faculty
Nahdlatul Ulama Surabaya University
Surabaya, Indonesia
tridevi@unusa.ac.id

***Abstract*— This paper presented a method to make an application for determination of blood chemistry. Blood chemistry consists of blood glucose, uric acid and cholesterol. The method consists of four steps. The steps were a literature study step, design application step, implement application step and testing application step. Literature study step aimed to get information about the theory of the determination of blood glucose, uric acid, and cholesterol. Design application step consists of design flowchart and interface. Implement application step was converting design flowchart and interface into application in Macromedia Flash. Method in testing application was white-box testing. White-box testing method is used for logical and analytic test in unit test level and can helps spot hidden errors in the code. It is shown that cyclomatic complexity of glucose determination is six, cyclomatic complexity of uric acid determination is four and cyclomatic complexity of cholesterol determination is three. In future work, the application could be implemented into the web-based application and mobile application.**

Keywords—macromedia flash, health application, blood glucose, uric acid, cholesterol

I. INTRODUCTION

Basic health research on 2018 by Ministry of Health Republic of Indonesia show that prevalence of non-communicable diseases increase rapidly if compared with those in basic health research on 2013 [1]. Non-communicable diseases consist of cancer disease, stroke, chronic kidney disease, diabetes mellitus, hypertension and heart disease. Increment of prevalence of non-communicable diseases have related with not healthy lifestyle such as smoking habit, alcohol consumption, lack of physical activity and lack of consumption of fruits and vegetables [2]. One of effort from Ministry of Health Republic of Indonesia in prevention and control non-communicable was CERDIK behavior program. CERDIK behavior was a health slogan with meaning such as routinely health check, get rid of cigarette smoke, diligent physical activity and manage stress [3]. Routinely health check like examination of blood chemistry. Blood chemistry included blood glucose, uric acid and cholesterol.

Hyperglycemia was a medical condition in the form of an increase in blood glucose levels exceeding normal limits. Hyperglycemia was one of mark in diabetes mellitus [4]. Insulin is a hormone that functions to regulate blood glucose level. If there are some pathological errors, the body cannot produce insulin itself or a condition where the body's cells cannot use insulin. Poor management can cause serious illness, including stroke, kidney failure, nervous system disease, premature death, leg amputation due to ulceration, and blindness [5]. A patient is termed diabetic when blood glucose greater than 125 mg/dL while fasting and greater than 199 mg/dL while not fasting. A patient has impaired glucose tolerance or pre-diabetes with fasting plasma glucose of 100 mg/dL to 125 mg/dL while fasting and not fasting plasma glucose of 140 mg/dL to 199 mg/dL. A patient is termed normal blood glucose levels while fasting plasma glucose less than 100 mg/dL and while not fasting plasma glucose less than 140 mg/dL [6].

Gout arthritis was the term used for a group of metabolic disorder. The sign of this disease is marked by increasing the level of uric acid (hyperuricemia). Numerous risk factors for the development of gout have been established including hyperuricemia, genetic factors, dietary factors, alcohol consumption, metabolic syndrome, hypertension, obesity, diuretic use and chronic renal disease [7]. Hyperuricemia occurs when uric acid reached more than 5,7 mg/dl in a woman and 7,0 mg/dl in a man [8].

Cholesterol is a fat or lipid in our body. Cholesterol is oil-based, so it does not mix with the water-based blood. It flows through our body through the bloodstream. If cholesterol were simply dumped into the bloodstream, it would congeal into unusable globs. To fix this problem, the body packages cholesterol and other fats into minuscule protein-covered particles called lipoproteins that do mix easily with blood [9][10]. When there is too much cholesterol in the blood, it builds up in the walls of your arteries. This builds up causes hardening of the arteries so that arteries become narrowed and blood flow to the heart is slowed down or blocked. Wall in arteries indicates high blood cholesterol. In cholesterol level, there are three categories such as normal, borderline high and high. Cholesterol is called normal if the cholesterol level is less than 200 mg/dL. Cholesterol level is around 200 until 239 mg/dL is included in the borderline high category. High blood cholesterol is called when the cholesterol level is 240 mg/dL and above [11].

978-1-7281-3832-9/19/$31.00 ©2019 IEEE

To make it easier for the community to undergo routine checks on blood chemistry, this research design and implement an application for determination of blood chemistry. The application is based on Macromedia Flash. Macromedia Flash is an application is used to build and create things related to computer graphics such as multimedia, interactive animations on web pages, application and advertisements [12]. In 2013, Ga successful makes design and implement a typing game for commonly used Tibetan words. It achieves the vocabulary display, fall, Tibetan input, counting score and output result. That application is used as a learning tool for Tibetan learners as well as a teaching tool for teachers [13]. In 2017, Kurniastuti also makes application of baby's nutrition status using Macromedia Flash. The application consists of the anthropometry like age, gender, weight, height and head circumference of a baby as input. The output of the application results comparable with the standard of nutrition status from the Ministry of the Health Republic of Indonesia. The accuracy of the application was 100% based on a similarity between the output of application and standard of nutrition status from the Ministry of Health Republic Indonesia [12].

II. METHODOLOGY

The flow diagram of methodology that has been used in this paper is shown in Figure 1. It consists of the literature study, design application, implement application and testing application.

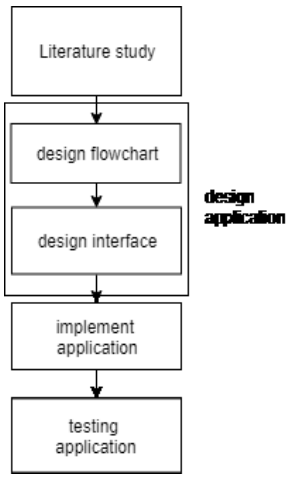

Figure 1. Flow diagram of methodology

The first step of research was literature study. Literature study was method to searching from books, media, experts or from the results of other people's research that aims to form the basis of theory is used in conducting research. Theory of blood glucose, uric acid and cholesterol is result of this step. The next step was design application. Design application consist of design flowchart and design interface. Design flowchart was a step to make algorithm of application. Flowchart can be made using Visio. Design interface was step to make design of Graphical User Interface. Graphical User Interface (GUI) was a form that consist of visual and text. User can be interaction with the application through GUI. Design GUI can be done by software is called evolus pencil. Evolus pencil is an open source application used to design an user interface [14]. GUI must be user friendly toward user [12]. The third step was implement application. This step convert flowchart become code program using Macromedia Flash. The last step was testing application. Testing application is an effective sampling method to measure software reliability. Software reliability refers to the probability of failure-free operation of a system [15]. One of technique in software testing is white-box testing. White-box testing method is used for logical and analytic test in unit test level. It can helps spot hidden errors in the code. [16]. White-box testing would give information about cyclomatic complexity. Cyclomatic complexity is a software metric used to indicate the complexity of a program. It is can be calculated using Equation 1.

$$V(G) = E - N + 2 \quad (1)$$

Where V(G) is cyclomatic complexity, E is total of edge in flow graph, N is total of node in flow graph.

III. RESULT AND DISCUSSION

This section were show result of research and discusses on the results. This research consists of four steps. That were the literature study, design application, implement application and testing application. Literature study resulting in theory of determination of blood glucose, uric acid and cholesterol. Besides that, the information in the health industry resulted from a literature study.

A. Design Application

Design application consists of a flowchart and design interface. the flowchart was a part with symbols that show introduction in the application. Theory from literature study is used as basic to design flowchart. In this paper, there were three flowcharts such as flowchart for determination of blood glucose, flowchart for determination of uric acid and flowchart for determination of cholesterol. That flowchart is shown in Figure 2 until Figure 4.

Figure 2 shown that determination of blood glucose influenced by the condition of patient which in fasting or not fasting condition. In fasting condition, the body experiences changes in blood glucose control due to changes in patterns and schedule of eating and physical activity [4]. Output in Figure 2 was normal, pre-diabetes and diabetes. Figure 3 showed a flowchart for determination of uric acid. The Defining factor in the determination of uric acid was gender. The output in Figure 3 was gout arthritis and normal. And flowchart for determination of cholesterol showed in Figure 4. Cholesterol level did not have a defining factor. The output of determination of cholesterol was normal, borderline high and high.

After making the design flowchart, the next was the design interface. The interface made using Evolus Pencil software. The application would be consists of five interfaces. The first interface consists of the title of application and introduction of the application. On this interface is equipped with a start button that functions as an entry button in the application. The second interface consists of the choice that served in the application. That was a determination of blood

glucose, uric acid, and cholesterol. Also, there was an exit button which is used as a button to exit from the application. In the third interface show a display of determination of blood glucose. The fourth interface shows a display of determination of uric acid and the last interface shows a display of determination of cholesterol. From the third interface until the fifth interface, a form has three buttons such as process button, back button and reset button. Process button was a button to begin process determination so that output is shown in the application. Back button was a button to back to the second interface so a user can operate the application in once entry. The reset button has a function to clear data in the application. All interface is shown in from Figure 5 until Figure 9.

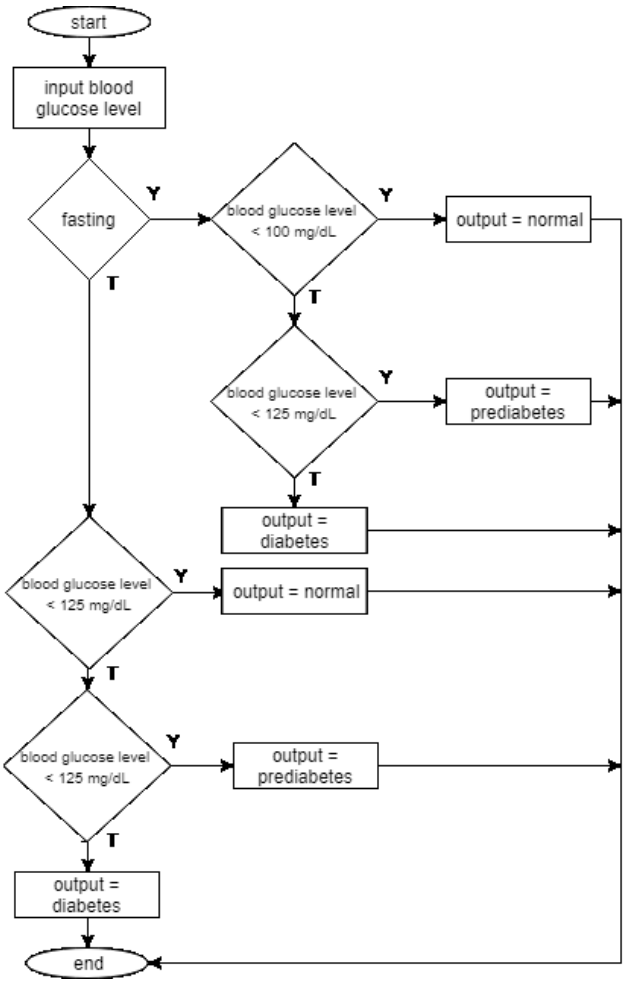

Figure 2. Flowchart for determination of blood glucose

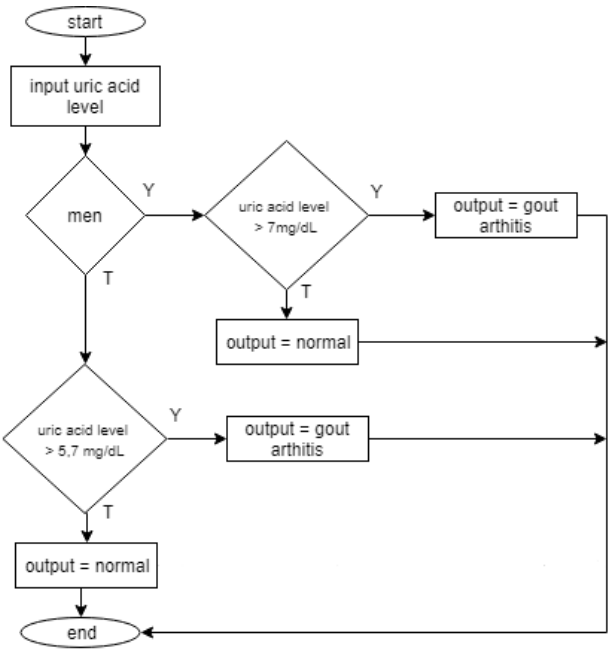

Figure 3. Flowchart for determination of uric acid

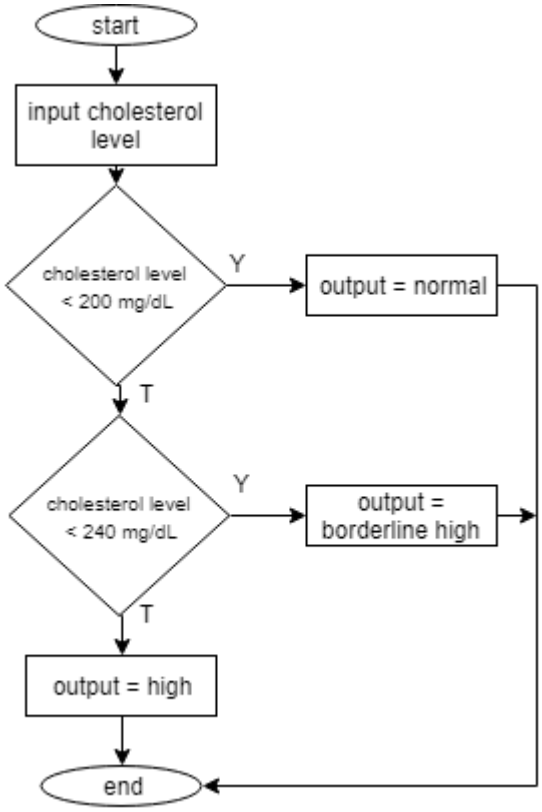

Figure 4. Flowchart for determination of cholesterol

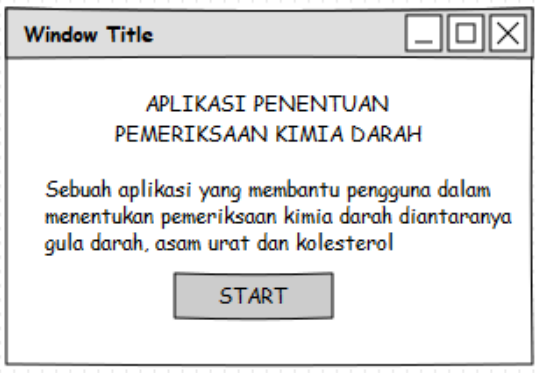

Figure 5. Display of the first interface in application

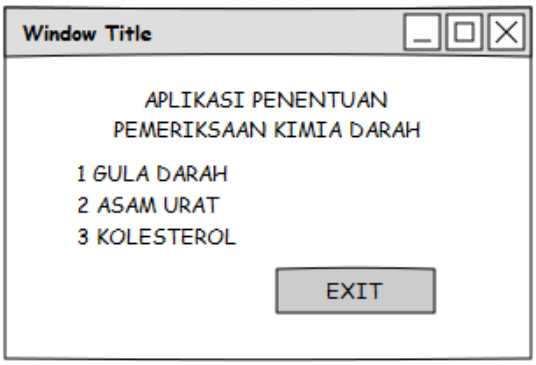

Figure 6. Display of the second interface in application

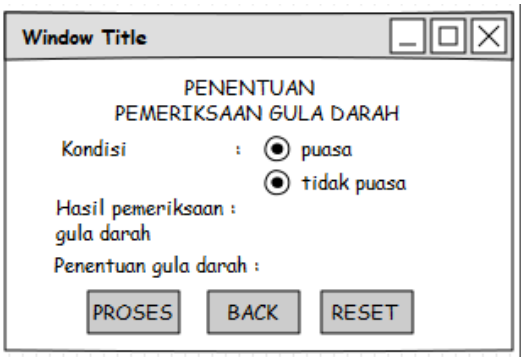

Figure 7. Display of the third interface in application

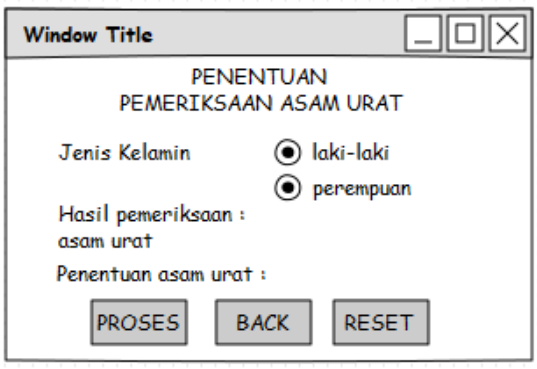

Figure 8. Display of the fourth interface in application

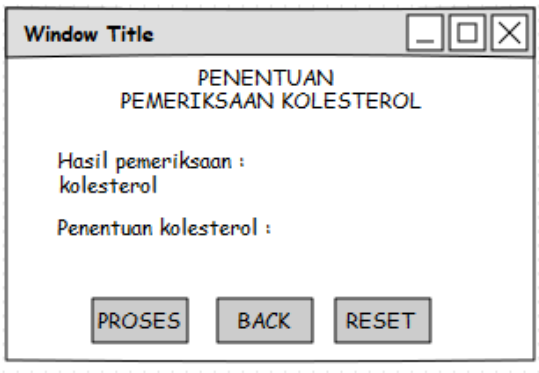

Figure 9. Display of the last interface in application

B. Implement Application

Implement application step was converting design flowchart and design interface into an application. This step is utilizing macromedia flash software. Design flowchart is placed in action button part in macromedia flash while design interface is placed in frame in macromedia flash. Frames in macromedia flash consist of five frame appropriate with design interface is done in previous step. These five frame is showed in Figure 10 until Figure 14.

Figure 10. Display of the first frame

Figure 11. Display of the second frame

Figure 12. Display of the third frame

Figure 13. Display of the fourth frame

Figure 14. Display of the fifth frame

C. Testing Application

In the last steps in paper was testing application using white-box testing. In white-box testing, source code of application converted into flow graph. In this paper, there was three flowchart and three source code so the number of flow graph was three such as flow graph of glucose, flow graph of uric acid and flow graph of cholesterol. These flow graph is shown in Figure 15 until Figure 17. Based on Figure 15, the total of node was 13 and the total of edge was 17. Cyclomatic complexity of glucose determination can be calculated using Equation 1 and from Equation 2, cyclomatic complexity of glucose determination is six (6). Independent path of glucose determination was six paths such as 1-2-3-4-13, 1-2-3-5-6-13, 1-2-3-5-7, 1-2-8-9, 1-2-8-10-11,and 1-2-8-10-12.

$$V(G) = E - N + 2 = 17 - 13 + 2 = 6 \quad (2)$$

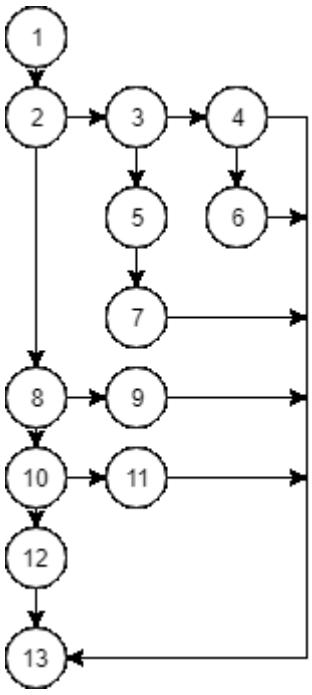

Figure 15. Flow graph of glucose determination in application

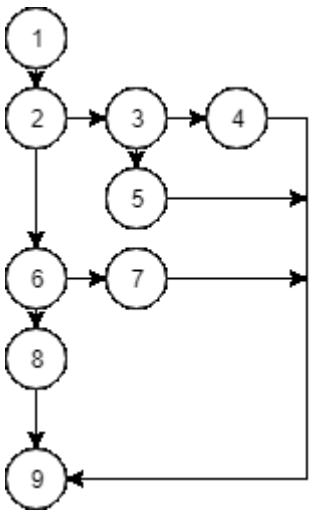

Figure 16. Flow graph of uric acid determination in application

In Figure 16, it is shown that the total of node was 9 and the total of edge was 11. Cyclomatic complexity of uric acid determination can be calculated using Equation 1 and from Equation 3 is obtained cyclomatic complexity of uric acid determination is four (4). Independent path of uric acid determination was four paths such as 1-2-3-4-9, 1-2-3-5-9, 1-2-6-7-9, and 1-2-6-8-9. And figure 17 show flow graph of cholesterol determination in application. Cyclomatic complexity of cholesterol determination can be calculated using Equation 1 and from Equation 4 is obtained cyclomatic complexity of cholesterol determination is three (3). Independent path of cholesterol determination was three paths such as 1-2-3-7, 1-2-4-5-7, and 1-2-4-6-7.

$$V(G) = E - N + 2 = 11 - 9 + 2 = 4 \quad (3)$$

$$V(G) = E - N + 2 = 8 - 7 + 2 = 3 \quad (4)$$

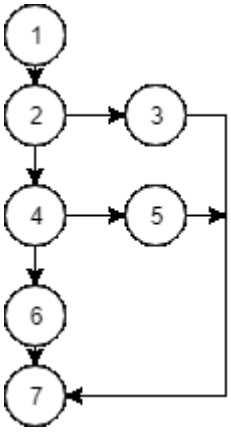

Figure 17. Flow graph of uric acid determination in application

IV. CONCLUSION

This paper consists of four steps. The steps were literature study step, design application step, implement application step and testing application steps. Literature study step aimed to get information about the theory of the determination of blood glucose, uric acid, and cholesterol. Design application step consists of design flowchart and interface. Implement application step was to convert design flowchart and interface into application in Macromedia Flash. The purpose of testing application steps was to measure software reliability. Method in testing application is white-box testing. It is shown that cyclomatic complexity of glucose determination is six, cyclomatic complexity of uric acid determination is four and cyclomatic complexity of cholesterol determination is three. In future work, the application could be implemented based on web and mobile application.

REFERENCES

[1] Ministry of Health Republic of Indonesia, "Basic Health Research 2018", original title Riset Kesehatan Dasar 2018, Kementerian Kesehatan Republik Indonesia, Jakarta, Indonesia, 2018.

[2] Ministry of Health Republic of Indonesia, "Non-communicable Diseases, The Most Common Causes of Death in Indonesia", original title Penyakit Tidak Menular (PTM) Penyebab Kematian Terbanyak di Indonesia", accessed through http://www.depkes.go.id, 2011.

[3] Ministry of Health Republic of Indonesia, "CERDIK", Direktorat Pencegahan dan Pengendalian Penyakit Tidak Menular, Direktorat Jenderal Pencegahan dan Pengendalian Penyakit, Kementerian Kesehatan Republik Indonesia, Jakarta, Indonesia, 2016.

[4] Perkeni, "Consensus on the Management and Prevention of Type 2 Diabetes Mellitus in Indonesia", original title from Konsensus Pengelolaan dan Pencegahan Diabetes Melitus Tipe 2 di Indonesia tahun 2015. Perkumpulan Endokronologi Indonesia, 2015.

[5] S Coster, MC Gulliford, PT Seed, JK Powrie, R Swaminathan, "Monitoring Blood Glucose Control in Diabetes Mellitus : A Systematic Review", Health Technology Assessment, Volume 4 No. 12, 2000.

[6] Mouri. Michelle, Badireddy. Madhu, "Hyperglycemia", StatPearls Publishing, January 2019.

[7] Roddy, E., Doherty, M. "Epidemiology of Gout", Arthritis Research and Therapy, Volume 12 No 6 December 2010.

[8] Rho YH. Zhu Y. Choi HK, "The Epidemiology of Uric Acid and Fructose", Seminars in Neprology, Volume 31 No. 5 September 2011.

[9] Yusoff. I.M.M, Yahya. R, Omar. W.R.W, Ku. L.C, "Non Invasive Cholesterol Meter Using Near Infrared Sensor" 2015 Innovation and Commercialization of Medical Electronic Technology Conference (ICMET), Shah Alam, Malaysia, 2015.

[10] Freeman MW. Junge C, "Understanding Cholesterol : The Good, The Bad and The Necessary," The Harvard Medical School Guide to Lowering Your Cholesterol, New York, United States of America : McGraw-Hill, 2005.

[11] U.S. Department of Health and Human Services, "High Blood Cholesterol What You Need to Know," U.S. Department of Health and Human Services. Public Health Service. National Institutes of Health. National Heart, Lung, and Blood Institute, United States of America, 2005.

[12] Kurniastuti. Ima, "Application of Baby's Nutrition Status Using Macromedia Flash, " 2017 4th International Conference on Computer Applications and Information Processing Technology (CAIPT), 2017.

[13] Ga. Zhuo, "Design and Implement a Typing Game for Commonly Used Tibetan Words based on the Macromedia Flash," 2013 2nd International Symposium on Instrumentation and Measurement, Sensor Network and Automation (IMSNA), 2013.

[14] Evolus, "Features of Evolus Pencil", 2016.

[15] Mohan. K. Krishna, Verma. A. K., Srividya. A., "Software Reliability Estimation Through Black Box and White Box Testing at Prototype Level," 2010 2nd International Conference on Reliability, Safety and Hazard (ICRESH-2010), pp 517-522, 2010.

[16] Seo. Kwang Ik, Choi. Eun Man, "Comparison of Five Black-box Testing Methods for Object-Oriented Software," Proceedings of the Fourth International Conference on Software Engineering Research, Management and Application (SERA '06), 2006.