

Kuinam Kim
Nikolai Joukov
Editors

Information Science and Applications 2017

ICISA 2017

Kuinam Kim · Nikolai Joukov
Editors

Information Science and Applications 2017

ICISA 2017

 Springer

Prioritized Process Test: More Efficiency in Testing of Business Processes and Workflows 585
Miroslav Bures, Tomas Cerny, and Matej Klima

Static Testing Using Different Types of CRUD Matrices 594
Miroslav Bures and Tomas Cerny

Extracting Test Cases with Message-Sequence Diagram for Validating the Photovoltaic Energy Integrated Monitoring System. 603
Woo Sung Jang, Bo Kyung Park, Hyun Seung Son, Byung Kook Jeon, and R. Young Chul Kim

Automatic Test Case Generation with State Diagram for Validating the Solar Integrated System 609
Bo Kyung Park, Woo Sung Jang, Hyun Seung Son, Keunsang Yi, and R. Young Chul Kim

Comparison of Software Complexity Metrics in Measuring the Complexity of Event Sequences 615
Johanna Ahmad and Salmi Baharom

Implementation of Ceph Storage with Big Data for Performance Comparison. 625
Chao-Tung Yang, Cai-Jin Chen, and Tzu-Yang Chen

Web Technology

Predicting Engaging Content for Increasing Organic Reach on Facebook 637
Natthaphong Phuntusil and Yachai Limpiyakorn

Learning Performance Evaluation in eLearning with the Web-Based Assessment 645
Cheng-Ying Yang, Tsai-Yuan Chung, Min-Shiang Hwang, Cheng-Yi Li, and Jenq-Foung JF Yao

Improving Teaching and Learning in Southeast Asian Secondary Schools with the Use of Culturally Motivated Web and Mobile Technology 652
Sithira Vadivel, Insu Song, and Abhishek Singh Bhati

Game-Based Learning to Teach Assertive Communication ClickTalk for Enhancing Team Play 660
Bah Tee Eng

Cloud Storage Federation as a Service Reference Architecture. 668
Rene Ivan Heinsen, Cindy Pamela Lopez, Tri D.T. Nguyen, and Eui-Nam Huh

Extracting Test Cases with Message-Sequence Diagram for Validating the Photovoltaic Energy Integrated Monitoring System

Woo Sung Jang¹, Bo Kyung Park¹, Hyun Seung Son¹, Byung Kook Jeon²,
and R. Young Chul Kim^{1(✉)}

¹ SELab, Department of CIC (Computer and Information Communication),
Hongik University, 2639, Sejong-ro, Jochiwon-eup, Sejong special self-governing city,
30016, Republic of Korea

{jang, park, son, bob}@selab.hongik.ac.kr

² Department of Software, Gangneung-Wonju National University,
Wonju, Gangwon Province 26403, Korea
jeonbk@gwnu.ac.kr

Abstract. Recently, in the photovoltaic energy integrated monitoring software system, it has more complex, and accordingly may be possible to occur more errors. In this industrial services, a small error can lead to a huge accident to make the power failures. To completely build this system, it should verify whether it is or not stability of software through measuring the full coverage with generating test cases in detail level based on a message sequence model. In this paper, we apply to verify a system stability of this monitoring system with our previous research such as the automatic test case generation based on UML 2.4.1 message-sequence diagram via cause-effect diagram. With this, we extract automatically test cases on coverage.

Keywords: Automatic test case generation · Message-sequence diagram · Renewable energy · Integrated monitoring system

1 Introduction

Approximately it occurs sixty percent of the software errors in the pre-design stages as well as the design stage, while only 40% of them in the post-design stages [1]. Furthermore, the requirements from the pre-design stages are likely to have uncertain and incomplete defects, so they are not easily detected. Also, when the requirement is misinterpreted, it would cause another issue that new software needs to be redeveloped. That is, one of the main reasons that causes software errors is a test case based on incomplete requirements [2].

Model-based testing tools generally decrease the number of incomplete test cases caused by requirements. If requirement-based test cases are generated in the design stage and test cases are implemented for a system development, the modules being developed based on misinterpreted requirements would be identified more quickly.

The existing methods generate model-based test case with Use Case Diagram [3]. In this paper, we use Message-Sequence Diagram method [4, 5]. Using the Sequence Diagram, we are to generate test cases satisfied with 100% coverage of software with “Metamodel

oriented Test Case Generation Method Based on transforming UML 2.4.1 Message-Sequence Diagram via Cause-Effect Diagram” [6].

In this paper, a test case would be extracted by applying a Message-Sequence Diagram drawn in the design stage to the previous approach [6] in order for the stability of the solar energy total monitoring system to be verified.

The outline of this paper is as introduced below. Section 2 describes related works including a method of metamodel oriented test case generation on the new & renewable energy total monitoring systems. In Sect. 3, Message-Sequence Diagram of solar energy total monitoring system is to be designed. And Sect. 4 describes the test case extraction of the solar energy total monitoring system, followed by conclusion and further studies.

2 Related Works

2.1 The Integrated Monitoring System for New and Renewable Energy

On the integrated monitoring system for new & renewable energy, we need to have a standard interface that interprets different types of data to be delivered to various kinds of energy plants. Because the standard interface is designed based on metamodel, a new data type is easily added into it. This is, plug and play on heterogeneous solar devices. Therefore, it provides total monitoring services based on web server, so each customer can easily track the current power via web browser. It also may provide prediction of the power using statistical methods for big data [7]. Figure 1 shows its total structure of this system.

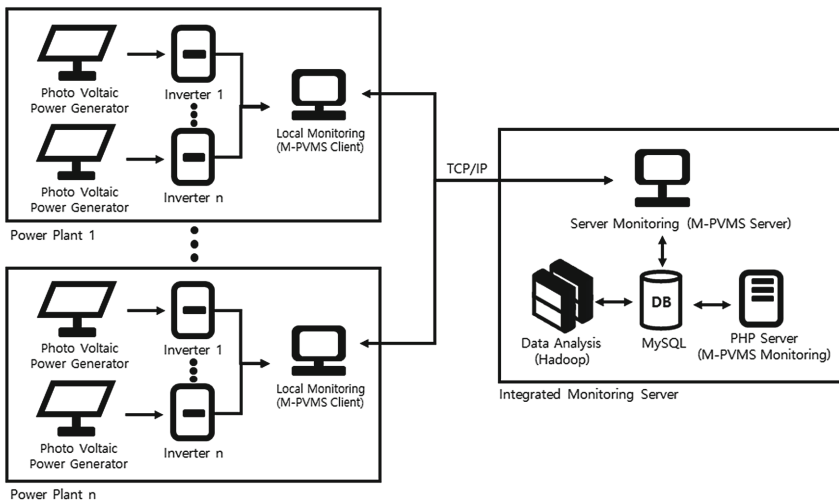


Fig. 1. The total structure of integrated monitoring system

2.2 Metamodel Oriented Test Case Generation

We use Message-Sequence Diagram to be transformed to Cause-Effect Diagram, and then generate test cases based on Cause-Effect Diagram with 100% of functional requirement coverage, which would be fulfilled by using minimal test cases only.

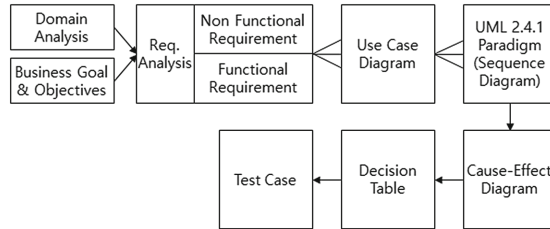


Fig. 2. A mechanism of test case generation in detail level from requirements

Figure 2 shows the detail of the process of test case generation that we analyze and design Use Case Diagram; Message-Sequence Diagram is designed by using each Use Case in the Use Case Diagram; Message-Sequence Diagram is transformed to Cause-Effect Diagram; Cause-Effect Diagram is transformed to decision table; and decision table turns into a test case.

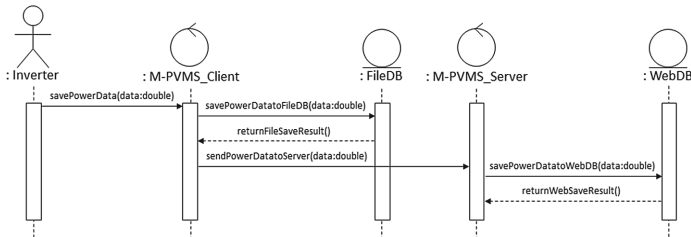


Fig. 3. The flow of saving the power data at most cases

3 A Message-Sequence Diagram in the Integrated Monitoring System

In this paper, with requirements, we draw the interaction with the system, that is, Message-Sequence Diagram in order to increase stability of the integrated monitoring system for new & renewable energy. As an example, the saving function of the power data in the system is drawn with Message-Sequence Diagram. From the diagram, test cases are to be extracted.

The saving of the power data into the server is a function to store data delivered from inverters. The flow of saving the power data at the most cases is seen in Fig. 3. The M-PVMS Client delivers data of inverter to M-PVMS server, and stores it into FileDB. M-PVMS server then stores the delivered data into WebDB.

Table 1. Message-sequence diagram codes for power data saving function in most cases

```

<?xml version="1.0" encoding="UTF-8"?>
<sed:SEDModel xmi:version="2.0" xmlns:xmi="http://www.omg.org/XMI"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:sed="http://sed/1.0" name="Model">
  <mMessage name="savePowerData" startMessage="//@mLimeline.0"
endMessage="//@mLimeline.1"/>
  <mMessage name="savePowerDatatoFileDB" startMessage="//@mLimeline.1"
endMessage="//@mLimeline.2"/>
  <mMessage name="returnFileSaveResult" startMessage="//@mLimeline.2"
endMessage="//@mLimeline.1"/>
  <mMessage name="sendPowerDatatoServer" startMessage="//@mLimeline.1"
endMessage="//@mLimeline.3"/>
  <mMessage name="savePowerDatatoWebDB" startMessage="//@mLimeline.3"
endMessage="//@mLimeline.4"/>
  <mMessage name="returnWebSaveResult" startMessage="//@mLimeline.4"
endMessage="//@mLimeline.3"/>
  <mLimeline name="Inverter" type="Actor" ownedMessage="//@mMessage.0">
    <mObkind xsi:type="sed:Actor"/>
  </mLimeline>
  <mLimeline name="M_PVMS_Client" type="Control"
ownedMessage="//@mMessage.0 //@mMessage.1 //@mMessage.2
//@mMessage.3">
    <mObkind xsi:type="sed:Control"/>
    <ecaRule mMessage="//@mMessage.0 //@mMessage.1"/>
    <ecaRule mMessage="//@mMessage.2 //@mMessage.3"/>
  </mLimeline>
  <mLimeline name="FileDB" type="Service" ownedMessage="//@mMessage.1
//@mMessage.2">
    <mObkind xsi:type="sed:Service"/>
    <ecaRule mMessage="//@mMessage.1 //@mMessage.2"/>
  </mLimeline>
  <mLimeline name="M_PVMS_Server" type="Control"
ownedMessage="//@mMessage.3 //@mMessage.4 //@mMessage.5">
    <mObkind xsi:type="sed:Control"/>
    <ecaRule mMessage="//@mMessage.3 //@mMessage.4"/>
  </mLimeline>
  <mLimeline name="WebDB" type="Service" ownedMessage="//@mMessage.4
//@mMessage.5">
    <mObkind xsi:type="sed:Service"/>
    <ecaRule mMessage="//@mMessage.4 //@mMessage.5"/>
  </mLimeline>
</sed:SEDModel>

```

The designed Message-Sequence Diagram needs to turn into XMI codes. In the power data saving function, Message-Sequence Diagram codes of the most cases are as seen in Table 1.

4 Test Case Extraction for New and Renewable Energy Monitoring System

The process to extract test case for solar energy total monitoring system is as described below. The XML codes for Message-Sequence Diagram are to be inputted to the automation tool, and then test case is to be extracted. The automation tool is applied by the model transformation rules based on ATL [6].

Generated XMI code for test case can be showed a chart format in Microsoft Excel. The Fig. 4 shows a test case extraction for power data saving function.

	A	B	C	D	E
1	ns2:version	no	testpre	testcon	testresult
2	2	TC1	savePowerData=F,savePowerDatatoFileDB=F	NORMAL	savePowerDatatoFileDB=F
3	2	TC2	savePowerData=T,savePowerDatatoFileDB=T	NORMAL	savePowerDatatoFileDB=T
4	2	TC3	returnFileSaveResult=F	NORMAL	returnFileSaveResult=F
5	2	TC4	returnFileSaveResult=T	NORMAL	returnFileSaveResult=T
6	2	TC5	sendPowerDatatoServer=F	NORMAL	sendPowerDatatoServer=F
7	2	TC6	sendPowerDatatoServer=T	NORMAL	sendPowerDatatoServer=T
8	2	TC7	savePowerDatatoWebDB=F	NORMAL	savePowerDatatoWebDB=F
9	2	TC8	savePowerDatatoWebDB=T	NORMAL	savePowerDatatoWebDB=T
10	2	TC9	savePowerDatatoWebDB=F	NORMAL	returnWebSaveResult=F
11	2	TC10	savePowerDatatoWebDB=F	NORMAL	returnWebSaveResult=T

Fig. 4. Test cases for the power data saving function

In model based testing based on requirements, we generate test cases from message sequence diagram via the cause effect diagram, which covers in detail level of the system. To validate the right requirements, we should generate all possible test cases which are satisfied by the requirements.

5 Conclusion

The volume of software is positively related to the number of errors in software. Because there are possibilities of life damage in the industrial field, an emphasis on development should have one of methods to increase reliability of software to industrial system.

By using “Metamodel oriented Test Case Generation Method Based on Transforming UML 2.4.1 Message-Sequence Diagram via Cause-Effect Diagram” we automatically generate test cases with any, and accordingly would be reduced the probability of inaccurate implementation in software.

In this study, test case is extracted by applying “Metamodel oriented Automatic Test Case Generation Method based on Transforming UML 2.4.1 Message-Sequence Diagram via Cause-Effect Diagram” in order to verify reliability of solar energy total monitoring system. Also, it is ascertained when the system functions are consistent with the demands.

In the future, we would be researched in the further study on methods of automated transformation of Message-Sequence Diagram into XMI codes.

Acknowledgments. This work was supported by the Human Resource Training Program for Regional Innovation and Creativity through the Ministry of Education and National Research Foundation of Korea (NRF-2015H1C1A1035548).

By Prof. Jeon, This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (NRF-2014R1A1A2058667).

References

1. NIPA, 2014 Software Engineering White Book, National IT Industry Promotion Agency (2014)
2. Chae, H.S.: Model-based test-concepts and issues. In: Korean Institute of Information Scientists and Engineers, vol. 32, no. 4, pp. 59–71 (2014)
3. Kim, R.Y.C., Joo, B.-G., Kim, K.-C., Joen, B.-K.: Scenario based testing & test plan metrics based on a user case approach for real time UPS (Uninterruptible Power System). In: Kumar, V., Gavrilova, M.L., Tan, C.J.K., L'Ecuyer, P. (eds.) ICCSA 2003. LNCS, vol. 2668, pp. 646–655. Springer, Heidelberg (2003). doi:[10.1007/3-540-44843-8_71](https://doi.org/10.1007/3-540-44843-8_71)
4. Kim, Y., Son, H.S., Kim, W., Seo, J., Kim, D., Seo, Y., Ryu, D., Kim, R.Y.C.: A study on modeling the obstacle avoidance UGV using extended executable UML. In: Joint Workshop on Software Engineering Technology 2007 (KSEJW-2007), pp. 108–116 (2007)
5. Woo, S., Son, H.S., Kim, R.Y.C.: A study on extending message-sequence diagram for mapping cause-effect diagram. In: Korea Information Processing Society, vol. 19, no. 1, pp. 1251–1254 (2012)
6. Woo, S.: Metamodel oriented automatic test case generation based on transforming UML 2.4.1 message-sequence diagram via cause-effect diagram. Hongik University (2012)
7. Jang, W.S., Son, H.S., Park, B.K., Kim, R.Y.C.: Implementation of effective web integrated monitoring system for small renewable energy business industries. In: Korean Institute of Smart Media, vol. 5, no. 1, pp. 303–305 (2016)