International Journal Software Engineering and Computer Science (IJSECS)
4 (2), 2024, 396-408
Published Online August 2024 in IJSECS (http://www.journal.lembagakita.org/index.php/ijsecs)
P-ISSN : 2776-4869, E-ISSN : 2776-3242. DOI: https://doi.org/10.35870/ijsecs.v4i2.2398.

RESEARCH ARTICLE Open Access

Design and Development of a Web-Based Complaints Management System at Syiah Kuala University Integrated Laboratory

Viska Mutiawani *
Informatics Study Program, Universitas Syiah Kuala, Banda Aceh City, Aceh Province, Indonesia.
Corresponding Email: viska.mw@usk.ac.id.

Pilar Al Hafist
Informatics Study Program, Universitas Syiah Kuala, Banda Aceh City, Aceh Province, Indonesia.
Email: pilar@mhs.usk.ac.id.

Rahmad Dawood
Computer Engineering Study Program, Universitas Syiah Kuala, Banda Aceh City, Aceh Province, Indonesia.
Email: rahmad.dawood@usk.ac.id.

Received: April 12, 2024; Accepted: July 10, 2024; Published: August 1, 2024.

Abstract: Complaint handling is essential to Syiah Kuala University's Integrated Laboratory Technical Management Unit (ILTMU) services. However, manual complaint handling at ILTMU requires more time and energy and increases the staff workload. Complaint handling is necessary to continuously improve the performance efficiency and service quality provided by ILTMU. Therefore, to solve the problem of handling complaints manually, this research intends to design and develop a web-based complaint management system at ILTMU of Syiah Kuala University. The proposed system uses the Goal-Directed Design method, while the development process follows Scrum. The system was developed using Flask and some services from the Google Cloud Platform, namely, the Google App Engine and Google Cloud Datastore. The system is divided into four unique user groups. Each has access privileges and responsibilities: operators, Management, Follow-up, and Customers. Each of these user groups has its distinctive features. The entire features of this application were tested using both Black Box and White Box testing. All system functions were successfully executed using the Black Box testing technique. Meanwhile, the White Box testing returned a value of 100\% passed, indicating that the function being tested is error-free. A usability test was conducted with 20 respondents representing each user group using the USE Questionnaire on a 7-point Likert scale. The usability test results gave an overall average value of 6.13, which suggests that people have a positive attitude toward the system and that it is practical, easy to use, easy to learn, and satisfying.

Keywords: Complaints Management; Goal-Directed Design; Black Box Testing; White Box Testing; Use Questionnaire.

1. Introduction

A complaint is a disclosure of dissatisfaction by an individual or organization to a particular institution or unit related to the results of the provided products or services [1]. The submitted complaint is expected to be responded to by the relevant institution or unit. Complaints can be a very important source of information to measure the performance of an institution, which in this study is an integrated laboratory unit at Syiah Kuala University (USK). The complaint allows the institution to fix problems in its performance immediately. That way, the institution can improve the efficiency of its performance and service quality [2][2]. Good service quality from an institution or unit can provide opportunities to turn dissatisfied customers into satisfied customers and can even become regular customers [3]. Many institutions and research studies have developed systems to address public complaints such as the research conducted by [4][5]. There are also other studies addressing customer complaints [6]. However, these studies have not yet incorporated feedback features to assess and evaluate the performance of the complained institutions. Furthermore, there is a lack of tracking and resolving processes for the complaints submitted. This research will provide those features so that every complaint can be addressed effectively.

The institution that will be focused on this research is the Integrated Laboratory Technical Management Unit. The Integrated Laboratory Technical Management Unit (ILTMU) is one of the technical units within Syiah Kuala University that provides testing, calibration, and certification services with international standards. According to observations made at the ILTMU of Syiah Kuala University, complaint handling is currently done manually by receiving reports regarding complaints from customers which are submitted to the staff of the ILTMU through telephone, letters, email, or in-person for follow-up. The current complaint procedure is believed to be ineffective. This is due to the procedure for submitting a complaint requiring a large time delay starting from submitting a complaint to the decisive resolution of the complaint. Submission of complaints directly could also cause human errors such as inaccurate information and inaccurate communication between customers and the laboratory. Another problem that can arise from the manual complaint-handling process is the limited capability of the complaint-handling staff if there are simultaneously several reports regularly, it would cause the staff to be overwhelmed in handling incoming reports. This can cause the time lag required to receive reports and relay the report to the person who will follow up on the report. In addition, if there are many complaints reports, the demand for storage space needed is also getting bigger. The process of handling complaints manually is considered to require an unpredictable handling time, coupled with fairly long handling processes. In addition to requiring a lot of time, handling complaints manually also requires more energy and increases the workload for staff which affects the performance of the institution to become less efficient.

Based on the conducted observation, it is necessary to have a system that can simplify the procedure of handling complaints. The proposed solution to deal with problems arising from manual complaint handling is to build a complaint management system that runs in real-time to assist the handling of complaints by the ILTMU of Syiah Kuala University in managing complaints reported by customers and monitoring complaints through a web-based system. Therefore, this research will design and develop a web-based complaint management system at Syiah Kuala University's Integrated Laboratory Technical Management Unit.

Customer complaints are expressions of dissatisfaction directed at service providers due to perceived deficiencies in services. These complaints often arise from unsatisfactory experiences with a product or service, which can lead to negative word-of-mouth or customer churn [7]. When consumers encounter service performance that falls below their expectations, they are likely to lodge complaints. If these issues are not addressed, they can damage a company's reputation and financial outcomes. Therefore, having effective strategies for managing complaints is crucial, particularly in service industries where maintaining customer relationships is essential [8]. Complaint management involves receiving, investigating, resolving, and preventing customer complaints, as well as working to restore customer satisfaction [9]. Effective complaint management can enhance customer retention, prevent the spread of negative word-of-mouth, and improve financial performance [8]. Johnston (2002) identified several key processes for effective complaint management, including having a clear procedure, responding promptly, ensuring consistency and reliability, providing a single point of contact, making the complaint process accessible, and keeping complainants informed. Additionally, it involves understanding and training staff to handle complaints attentively and encouraging proactive problem-solving. The ultimate goal of these processes is not only to placate dissatisfied customers but also to use the feedback for organizational improvement and enhanced performance [10].

To support this, an information system should be employed to streamline the distribution of reports and information. This study proposes the design and development of a web-based complaint management system, utilizing the Goal-Directed Design (GDD) method. Developed by Alan Cooper, GDD focuses on creating user interfaces that meet user goals and needs by integrating ethnographic techniques, stakeholder input, market

research, detailed user models, scenario-based design, and core interaction principles [11]. The GDD process includes six stages: research, modeling, requirements, framework, refinement, and support. The development process will follow the Scrum framework, organizing work into cycles known as Sprints [12][13].

The proposed system will be built using Flask, a Python micro web framework, which simplifies routing, dynamic data handling, and user interactions [14]. It will leverage Google Cloud Platform services, including Google App Engine and Google Cloud Datastore. Google App Engine provides a serverless environment for scalable web app development, while Google Cloud Datastore offers a robust NoSQL database solution. The system will undergo testing through Black Box Testing, White Box Testing, and Usability Testing. White Box Testing will focus on the application's internal structure, examining logic, code structure, and control flow [15]. In contrast, Black Box Testing will evaluate the software's functionality, assessing whether it meets the specified requirements [16]. Usability Testing will involve real users to assess the system's ease of use, efficiency, and overall satisfaction, measured through the USE Questionnaire, which covers four dimensions: usefulness, ease of use, ease of learning, and satisfaction [17][18].

2. Research Method

An application development method is needed in the development process to produce software that is suitable for the needs of users. The research methodology incorporates the GDD method for designing and the Scrum method for developing the system. The stages of the research methodology are described in Figure 1.

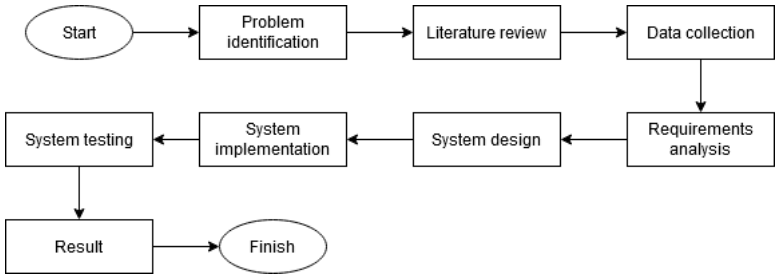

Figure 1. Research Methodology

2.1. Problem Identification

The problem identification stage serves as the initial phase of this research, crucial for pinpointing the issues at hand so that the findings from this stage can lay the groundwork for appropriate solutions. The identified problems include the manual recording of complaints related to the UPT of the Integrated Laboratory at Syiah Kuala University, which results in inefficient data management. Additionally, forwarding information about the follow-up on complaints to relevant officers is also handled manually, leading to delays in addressing the complaints. Furthermore, the process of updating the complainant on the status of their complaint is not digitized, preventing them from tracking their complaints effectively. Lastly, the accumulation of complaint archives and file data requires physical storage space, as the data is not stored digitally.

2.2. Literature Review

The literature review stage is an activity to obtain various references or information related to the research to be carried out. References can be searched from various data sources such as books, journals, research report articles, and websites on the internet related to the research topic. The information that has been obtained at this stage can then be used as a reference to obtain the formulation of problems, solutions, goals, and benefits to strengthen the theory of this research.

2.3. Data Collection

This stage commences with the identification of the different users involved in the complaint management system. In this study, data collection was carried out at the Integrated Laboratory of Syiah Kuala University (ILTMU) to understand the existing mechanisms for handling complaints. The research involved a detailed observation process, which included conducting direct interviews with various stakeholders, such as administrative staff, laboratory personnel, and students who have interacted with the system. These interviews provided valuable insights into the current practices and challenges faced in managing complaints. The goal was to capture a comprehensive view of the system's functionality, efficiency, and user satisfaction. By engaging with users directly, the research aimed to identify key areas for improvement, understand user needs

and expectations, and gather firsthand accounts of the system's performance. This thorough data collection process is crucial for developing a well-informed basis for proposing enhancements to the complaint management system, ensuring that the solutions devised are tailored to the real-world experiences and requirements of its users.

2.4. Requirement Analysis

The Requirements analysis stage begins with observing the complaint-handling process at the Integrated Laboratory of Syiah Kuala University. Then proceed with the user identification stage namely Customers, Operators, Management, and officers who follow up. At this stage, information is obtained about the problems that occurred during the complaint-handling process that has been implemented so far. The activity diagram of the system based on the results of the user's requirements analysis can be seen in Figure 2.

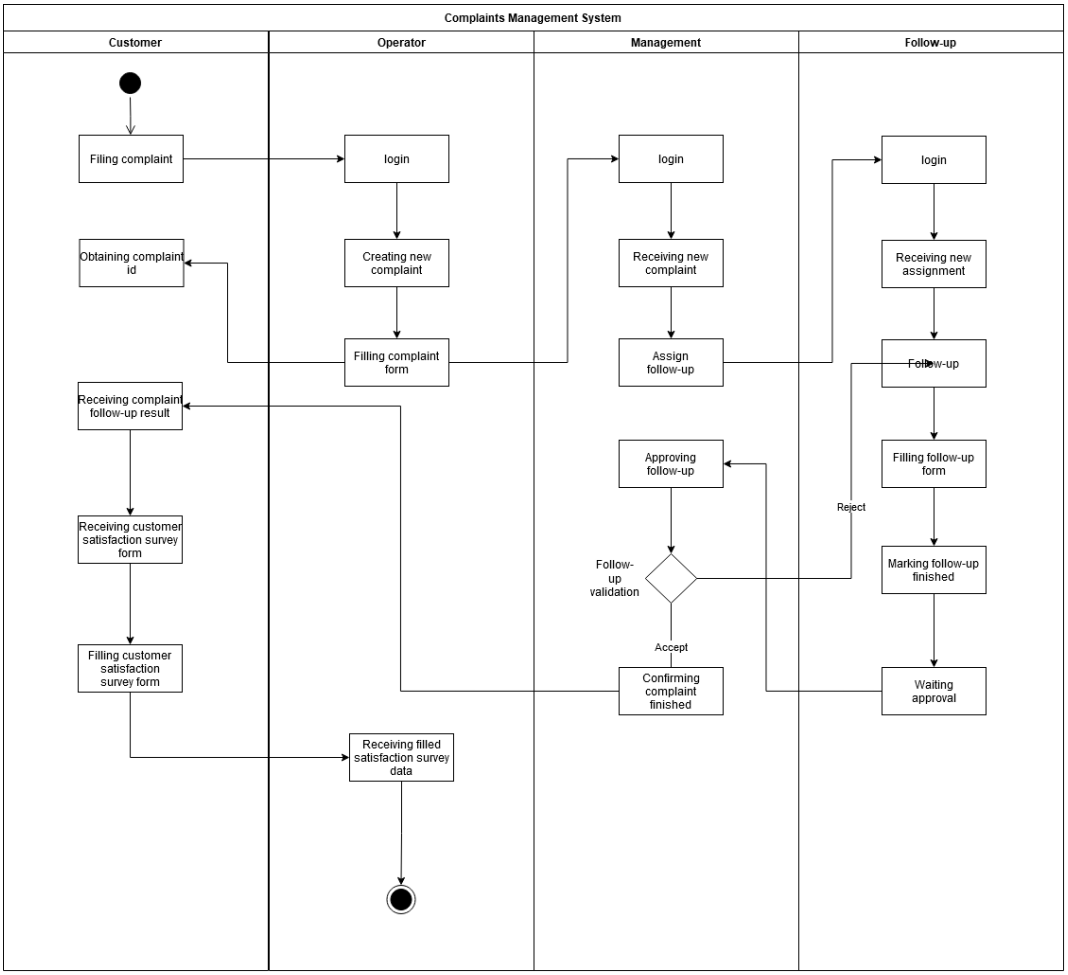

Figure 2. Activity Diagram

2.5. System Design

The system is designed by applying the Goal-Directed Design. This method was developed by Alan Cooper who puts user goals at the center of the software development process. Cooper (2014) describes the six stages of the GDD method used in the design of the complaint management system at the ILTMU of Syiah Kuala University [11]. The result of this process can be described in a class diagram which is the basis for system design, the system class diagram can be seen in Figure 3.

Figure 3. Class Diagram

2.6. System Implementation

At this stage, the system is developed based on the design results from the previous phase. The development of the complaint management application system employs the Scrum methodology, an agile project management framework that focuses on iterative development, frequent inspection, and adaptation [12]. Scrum organizes work into short, fixed-length iterations known as sprints, which typically last between 1 to 4 weeks [12]. The system is divided into two main components: the front-end and the back-end. The front-end is responsible for the user interface, which facilitates direct interaction between users and the system through a desktop interface. It is constructed using the Jinja2 template engine in Python, which defines the visual aspects of the system. Information exchange between the system environment and Google App Engine is managed through CRUD operations via a RESTful Web Service, which returns JSON and form data. The back-end, built with the Flask framework in Python, handles the core functionality of the system. It is supported by various JavaScript components to integrate features with Google App Engine. For data management, the system utilizes Google's Datastore, a NoSQL database that offers a schema-less, non-relational structure as part of the Google Cloud Platform services. Additionally, Google Cloud Storage is employed to manage and store objects such as documents and images, allowing for efficient upload and download operations. The interaction between the front-end and back-end is depicted in a deployment diagram, which illustrates how these components work together to support the system's functionality and data management. Figure 4 provides a visual representation of this interaction.

2.6. System Testing

System testing is the stage where a system launch process is carried out to find errors and test whether the system is running well. This test aims to find deficiencies in the system and to prove whether the designed system is following the expected functionality or not. System testing is carried out by using Black Box Testing, White Box Testing, and Usability Testing methods.

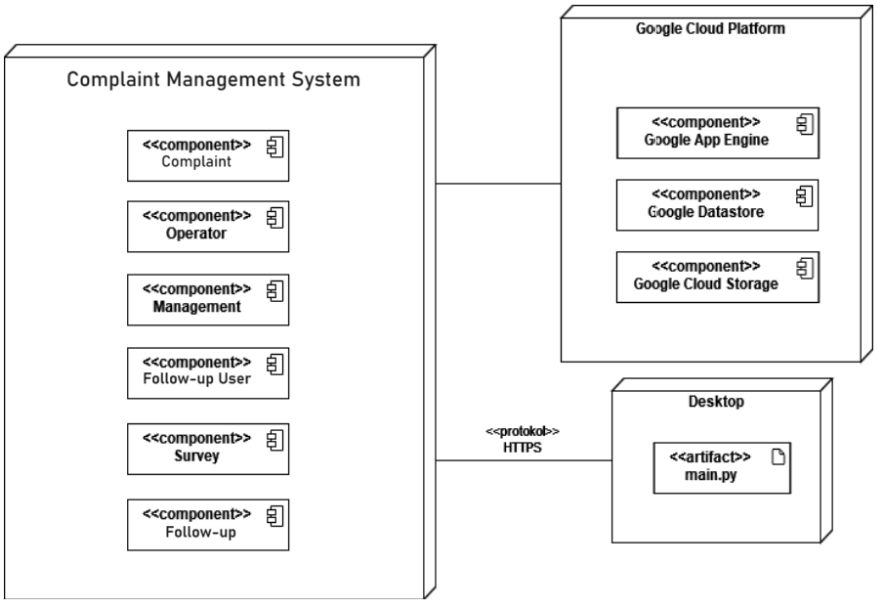

Figure 4. Deployment Diagram

Black Box Testing is employed to assess the system's functionality without examining its internal workings. This approach focuses on validating the outputs generated from given inputs, ensuring that the system performs as expected from an end-user perspective. White Box Testing, on the other hand, examines the internal logic and structure of the application. It involves analyzing the code, internal algorithms, and control flows to identify potential issues that might affect the system's performance. Finally, Usability Testing is conducted to evaluate the system's user-friendliness and overall user experience. This involves testing the system with real users to gather feedback on its ease of use, effectiveness, and satisfaction.

3. Result and Discussion

3.1 Results

The developed complaint management system is an internal system being used by the staff of Syiah Kuala University's ILTMU to handle complaints effectively and efficiently. This system consists of 4 groups of users with each interface and access rights, namely customer, operator, management, and follow-up user. Customers are users who submit complaints to Syiah Kuala University's ILTMU. Customers cannot enter the application by logging in because they do not have a special account that has these access rights; however, customers can view the status of the complaint they submitted based on the id of the complaint obtained from the operator when the complaint is registered into the system (Figure 5). In addition, customers can fill out a customer satisfaction survey via a link obtained from the operator. The operator has the task of adding a new complaint submitted by the customer into the application and forwarding the **id** and the results of the follow-up to the complaint to the customer. Operators can log into the system with a registered email account. After logging into the system, the operator can see the entire list of complaints on the homepage. If there is a new complaint submitted by the customer, the operator can add a new complaint to the system by pressing the new complaint button and filling out the complaint form based on the complaint data submitted based on the files related to the complaint. Once a new complaint is added by operators, users with access rights as management will receive an email notification to be able to examine the complaint and assign staff related to the complaint to be able to follow up on the complaint. In addition, management can also determine the follow-up deadline for the staff to handle the complaint assigned to them. After the complaint is followed up by the staff and submitted, management will receive an email notification and be able to decide whether to accept the follow-up results or reject them after an inspection.

Follow-up plays a role in following up on complaints assigned to them. When a complaint is assigned by management to a staff with a position related to handling complaints, the staff with that position will receive an email notification regarding the deadline for following up on the complaint. The staff can then add a follow-up to the complaint and after the follow-up is deemed to have met the customer's needs, the staff can submit the results of the follow-up to be inspected by the management.

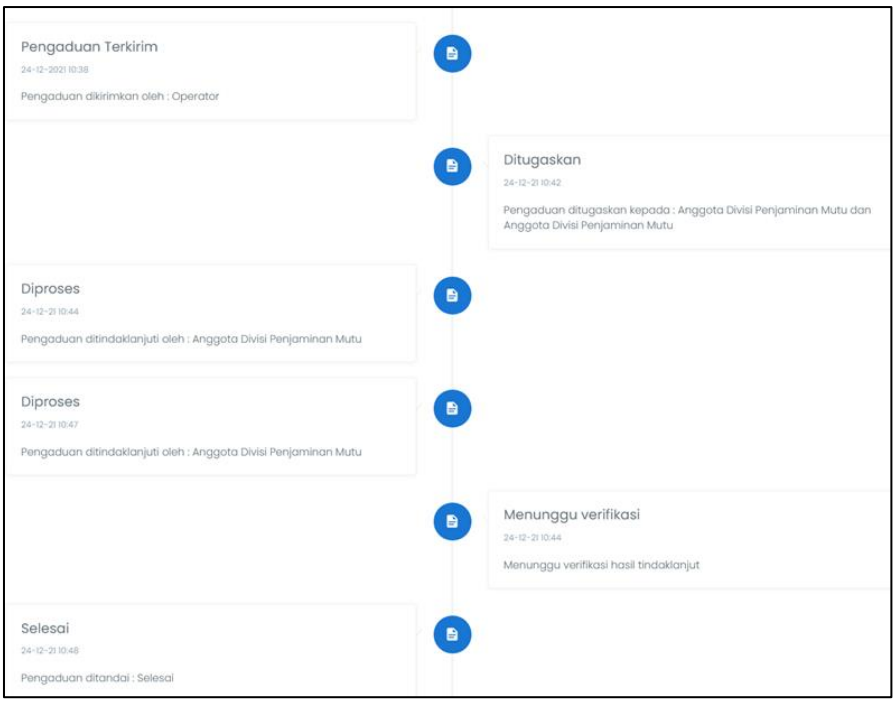

Figure 5. Complaint Status Page

The complaint management system is tested using both the Black Box and White Box testing to make sure all of the functionalities and code work as expected. The Black Box testing was done for both registered users and the customer interface. Testing for registered users begins with logging in and continues through logout for each task of every registered user. Each test prioritizes data input processes, both with correct and incorrect data, to ensure the system can handle all inputs, even unreasonable ones. Meanwhile, testing from the customer side will evaluate the tasks performed by the customer, namely tracking complaints and providing feedback on the complaint-handling process. An example of black-box testing on the customer interface can be seen in Table 1. All the scenarios being tested have passed the Black Box testing plan. This demonstrates that the application was successfully created and adhered to the system design.

Table 1. Black Box Testing for Customer User

No.	Testing	Scenario	Output	Result as Expected
1.	Viewing the detailed status of reported complaints.	Fill in the complaint ID form and press the Check Status button when finished.	Redirected to the complaint status page if successful.	Yes
2.	Viewing the detailed status of complaints with incorrect or unregistered IDs.	Fill in the form with an unregistered complaint ID and press the Check Status button when finished.	Displaying an error for an unregistered complaint.	Yes
3.	Filling out the satisfaction survey form.	Fill in the satisfaction survey form and press the Save button when finished.	Redirected to the thank you page after successfully submitting the survey.	Yes

Testing with the white-box method is a testing approach that analyzes the internal logic and code structure of the application. White-box testing in this research utilizes pytest, which is automation-based, by simulating user inputs into the system as parameters for testing. This testing is conducted to verify whether each function can produce appropriate output or not. Each test must run perfectly 100% for the testing to be considered successful, as shown in Figure 6. If a test fails, an output will appear as shown in Figure 7.


```
(env) C:\Users\ASUS\Documents\pengaduan\code\tests\views\login>python -m pytest test_auth.py
============================= test session starts =============================
platform win32 -- Python 3.10.2, pytest-7.0.0, pluggy-1.0.0
rootdir: C:\Users\ASUS\Documents\pengaduan\code\tests\views\login
collected 3 items

test_auth.py ...                                                         [100%]

============================== warnings summary ===============================
..\..\..\..\..\..\..\..\Python310\lib\site-packages\google\cloud\datastore_v1\services\datastore\client.py:17
  C:\Python310\lib\site-packages\google\cloud\datastore_v1\services\datastore\client.py:17: DeprecationWarning: The distu
e setuptools or check PEP 632 for potential alternatives
    from distutils import util

-- Docs: https://docs.pytest.org/en/stable/how-to/capture-warnings.html
======================== 3 passed, 1 warning in 1.16s =========================
```

Figure 6. Successful White Box Testing

```
(env) C:\Users\ASUS\Documents\pengaduan\code\tests\views\login>python -m pytest test_auth.py
============================= test session starts =============================
platform win32 -- Python 3.10.2, pytest-7.0.0, pluggy-1.0.0
rootdir: C:\Users\ASUS\Documents\pengaduan\code\tests\views\login
collected 3 items

test_auth.py .F.                                                         [100%]

================================== FAILURES ===================================
_____________________________ test_authorize _____________________________

    @login.route('/authorize')
    def test_authorize():

        # with app.test_request_context():

>       if "state" not in session:

test_auth.py:82:

C:\Python310\lib\site-packages\werkzeug\local.py:432: in __get__
    obj = instance._get_current_object()
C:\Python310\lib\site-packages\werkzeug\local.py:554: in _get_current_object
    return self.__local()  # type: ignore
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

name = 'session'

    def _lookup_req_object(name):
        top = _request_ctx_stack.top
        if top is None:
>           raise RuntimeError(_request_ctx_err_msg)
E           RuntimeError: Working outside of request context.
E
E           This typically means that you attempted to use functionality that needed
E           an active HTTP request.  Consult the documentation on testing for
E           information about how to avoid this problem.

C:\Python310\lib\site-packages\flask\globals.py:33: RuntimeError
============================== warnings summary ===============================
..\..\..\..\..\..\..\..\Python310\lib\site-packages\google\cloud\datastore_v1\services\datastore\client.py:17
  C:\Python310\lib\site-packages\google\cloud\datastore_v1\services\datastore\client.py:17: DeprecationWarning: The distutils package is deprecated and slated for removal in Python 3.12. Us
e setuptools or check PEP 632 for potential alternatives
    from distutils import util

-- Docs: https://docs.pytest.org/en/stable/how-to/capture-warnings.html
=========================== short test summary info ===========================
FAILED test_auth.py::test_authorize - RuntimeError: Working outside of request context.
====================== 1 failed, 2 passed, 1 warning in 1.40s =================
```

Figure 7. Failed White Box Testing

The usability analysis used in this application is the USE Questionnaire method. There are 30 questions in the questionnaire consisting of 8 questions related to usefulness, 11 questions related to ease of usage, 4 questions related to ease of learning, and 7 questions related to satisfaction. The questionnaire scoring system uses a Likert scale with 7 rating scales, namely very satisfied with a weight of 7, satisfied with a weight of 6, somewhat satisfied with a weight of 5, quite satisfied with a weight of 4, somewhat dissatisfied with a weight of 3, dissatisfied with a weight of 2, and very dissatisfied with a weight of 1. The system was tested on 20 respondents consisting of staff in ILTMU of Syiah Kuala University by following test plan directed for each user. An example of test plan for operator user can be seen in Table 2. After that, they were asked to fill out the USE questionnaire that was distributed online using Google Form. The calculation of user satisfaction using the USE questionnaire is done using a Likert scale measurement. The formula used to determine the interval scale on the Likert scale measurement can be seen in Formula 1.

$$RS = \frac{m-n}{b} \quad (1)$$

While **RS** is an interval scale, **m** is the highest number in measurement, **n** is the lowest number in measurement, and **b** is the number of classes/categories formed. The highest score in the assessment is 7 and the lowest number is 1, the number of categories formed in 7 categories. By applying the above formula, we get the interval scale for each category as can be seen in Table 3. The usability score is obtained by multiplying the number of frequencies by the weight of the assessment and dividing by the number of respondents. In other words, we calculate the average for each indicator in the USE Questionnaire. The number of frequencies is obtained by counting the number of respondents who choose a particular assessment weight. The results obtained from all respondents can be seen in Table 4.

Table 2. Test Plan for Operator User

Test Plan Usability Testing
Location : 1. Syiah Kuala University's Integrated Laboratory Technical Management Unit (ILTMU) 2. Aceh Inspectorate Building 3. Chemical Engineering Laboratory Building
Scenario : 1. User logs into the system 2. User views the list of complaints 3. User views the content of a complaint 4. User views the status of a complaint 5. User views survey statistics 6. User creates a new complaint 7. User logs out of the system
Tools : 1. Laptop or desktop computer to use the system
Result : The results of usability testing using the USE Questionnaire can be seen in Table 4.

Table 3. Rating Scale Interval

Score	Interpretation
1 ≤ score < 1.85	Very Dissatisfied
1.86 ≤ score < 2.7	Dissatisfied
2.71 ≤ score < 3.56	Somewhat Dissatisfied
3.57 ≤ score < 4.42	Neutral
4.43 ≤ score < 5.28	Somewhat Satisfied
5.29 ≤ score < 6.13	Satisfied
6.14 ≤ score ≤ 7	Very Satisfied

Table 4. Final USE Questionnaire Usability Score

Category	Indicator	Average	Result Interperation
Usefulness	1	5.9	Satisfied
	2	6.05	Satisfied
	3	6.5	Very Satisfied
	4	6.35	Very Satisfied
	5	6.3	Very Satisfied
	6	6.2	Very Satisfied
	7	6.25	Very Satisfied
	8	6.15	Very Satisfied
Average for u*sefulness*		6.21	Very Satisfied
Ease of Use	1	6.3	Very Satisfied
	2	6.25	Very Satisfied
	3	6.35	Very Satisfied
	4	6.05	Satisfied
	5	6.1	Satisfied
	6	6.05	Satisfied
	7	5.75	Satisfied
	8	6.35	Very Satisfied
	9	6.05	Satisfied
	10	6.1	Satisfied
	11	6.2	Very Satisfied
Average for *Ease of use*		6.14	Very Satisfied
Ease of Learning	1	5.8	Satisfied
	2	6.05	Satisfied
	3	6.3	Very Satisfied
	4	6.15	Very Satisfied

Average *Ease of Learning*		6.07	Satisfied
Satisfaction	1	6.25	Very Satisfied
	2	6.05	Satisfied
	3	6.05	Satisfied
	4	6.1	Satisfied
	5	5.75	Satisfied
	6	6.3	Very Satisfied
	7	6.3	Very Satisfied
Average *Satisfaction*		6.11	Satisfied
Total Average		6.13	Satisfied

From Table 4, most indicators have satisfied interpretation. For the usefulness category, all indicators are very satisfying; the average is 6.21, which means they are delighted. For the ease of use category, the overall indicator also falls into the very satisfying interpretation and averages 6.14. For the third category, ease of learning, the average is 6.07, which means satisfied; for the satisfaction category, the average is 6.11. From all of the results obtained, the total average is 6.13, meaning that respondents feel happy with the system. So, it can be used as a medium to handle complaints directed to the service of Syiah Kuala University's ILTMU. This usability testing result can also be verified from the mistakes made by each respondent, which range from 0 to 2. Therefore, the maximum number of mistakes found is 2, which occurred due to internet connection errors causing slow data loading and delays, resulting in users not receiving email notifications. An example of mistake counting for some Operator users can be seen in Table 5.

Table 5. Mistakes Made by Respondents of Operator User

Name	Scenarios							Count
	1	2	3	4	5	6	7	
User 1	0	0	0	0	0	0	0	0
User 2	0	0	0	0	0	1	0	1
User 3	0	0	0	0	1	0	0	1
User 4	0	0	0	0	0	0	0	0
User 5	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	1	0	2

3.2 Discussion

The developed complaint management system for Syiah Kuala University's Integrated Laboratory Technical Management Unit (ILTMU) represents a significant advancement in streamlining the complaint-handling process. The system is designed with four distinct user groups: customers, operators, management, and follow-up users, each with tailored interfaces and access rights. Customers who do not have login credentials can track the status of their complaints using an ID provided by the operator and participate in a satisfaction survey through a link shared by the operator. With their login accounts, operators are responsible for entering new complaints into the system and forwarding follow-up results and complaint IDs to customers. They access the entire list of complaints and can add new ones as needed. Management users receive notifications via email about new complaints, review them, assign tasks to appropriate staff, and set deadlines. They also assess follow-up results to determine if they meet the required standards. Follow-up users handle complaints assigned by management, receive deadline notifications, and submit resolutions for management review. The system underwent extensive testing using Black Box, White Box, and Usability Testing methods. Black Box Testing evaluated the system's functionality from the end-user perspective, ensuring accurate complaint tracking and survey submissions. The testing confirmed that the system met its functional requirements. White Box Testing focused on the internal code and logic, verifying that each function produced the correct output. Results from this testing showed the system's robustness and reliability. Usability Testing, conducted using the USE Questionnaire, assessed usefulness, ease of use, learning, and overall satisfaction. The results indicated high levels of user satisfaction, with an average score of 6.13, reflecting that users found the system effective and easy to use. Despite the generally positive feedback, some issues related to internet connectivity were observed, affecting data loading and email notifications. Nonetheless, the complaint management system has proven to be a valuable tool for handling complaints at ILTMU, enhancing efficiency and user satisfaction.

4. Related Work

Various methodologies and frameworks have been developed in complaint management systems to address the complexities of handling customer complaints effectively. Notably, the foundational standards for ensuring competence in such systems are outlined in the EN ISO/IEC 17025, which emphasizes accuracy and reliability—principles directly applicable to complaint management systems to ensure that complaints are handled with precision and consistency [1]. Building upon this, Suchaeri (2012) contributes significantly by discussing managing customer perceptions to drive profitability. This work underscores the need for complaint management systems to address issues and enhance overall customer satisfaction, a crucial aspect for long-term business success [2]. Similarly, Tjipto (2009) delves into the intricacies of complaint management, presenting methodologies that focus on systematic approaches to improving service quality and responsiveness [3]. Mursalim (2018) offers an in-depth analysis of online complaint management systems, such as the LAPOR system in Bandung, highlighting the benefits of digital platforms in increasing administrative efficiency and transparency. This study demonstrates how online systems can streamline the complaint-handling process, making it more accessible and efficient [4].

Mahbub *et al*. (2020) also contribute to this discussion by designing a web-based complaint system using UML, emphasizing the importance of structured and user-centered design to enhance system effectiveness [5]. The role of agile methodologies in developing complaint management systems is further supported by Sutherland and Coplien (2019) and Schwaber and Sutherland (2011), who discuss the Scrum framework. Their research highlights the iterative nature of Scrum, which allows for continuous improvement and adaptation, which is essential for meeting evolving user needs and addressing complaints promptly [12][13].

Verma *et al*. (2017) and Jan *et al*. (2016) provide valuable insights into both Black Box and White Box testing techniques. Their studies affirm the importance of rigorous testing to ensure that complaint management systems are both functionally robust and capable of effectively handling a range of inputs [15][16]. Furthermore, Jordan (2020) and Lund (2001) emphasize the significance of usability testing, using the USE Questionnaire to evaluate user satisfaction and ensure that systems are intuitive and user-friendly [17][18].

Recent studies build on these foundational works, adding new insights into the field of complaint management systems. Teplická *et al*. (2023) discuss improving the quality of automotive components through effective complaint management in Industry 4.0 [19]. Pio *et al*. (2023) compare traditional and digital banks, highlighting the benefits of using management systems to enhance complaint handling [20]. Additionally, Susanti (2021) explores how complaint-handling satisfaction mediates the relationship between complaint-handling and customer loyalty in the Indonesian banking industry [21]. El-Metwally (2013) analyzes complaint handling in the airline industry, focusing on enhancing customer loyalty [22].

These studies collectively inform the development and enhancement of complaint management systems, emphasizing the need for systematic approaches, technological integration, agile development, and usability considerations. The current research builds on these insights to create a web-based complaint management system tailored for Syiah Kuala University's Integrated Laboratory Technical Management Unit (ILTMU), aiming to improve complaint-handling processes through efficient design and user-centered functionalities.

5. Conclusion

The outcome of this research is a complaint management system specifically developed for Syiah Kuala University's Integrated Lab Technical Management Unit. Designed using the General Design and Development (GDD) method and implemented through the Scrum framework with the Flask framework, the application addresses the need for efficient complaint handling. Comprehensive testing included Black Box testing to assess external functionalities and White Box testing to evaluate internal structures. All test scenarios successfully passed, indicating that the system operates as intended. The application's usability was assessed using the USE questionnaire, which evaluates usefulness, ease of use, learning, and overall satisfaction. The scores for these categories were 6.21, 6.14, 6.07, and 6.11, respectively. The overall average score of 6.13 signifies that users are generally satisfied with the system. Currently, the application is designed for internal use by Syiah Kuala University's Integrated Lab Technical Management Unit staff and is limited to desktop computers. Future enhancements should focus on increasing compatibility with mobile devices to improve accessibility. Optimizing the system by reducing JavaScript usage could enhance performance and reduce page

load times. Implementing automatic notification features to update customers on the status of their complaints and incorporating machine learning algorithms to automate follow-up actions are also recommended for future development.

References

[1] Standard, B., *et al*. (2006). *General requirements for the competence of testing and calibration laboratories*, EN ISO/IEC 17025. p. 42.

[2] Suchaeri, H. (2012). *Total customer percepatan laba sepanjang masa*. Solo: PT Tiga Serangkai Pustaka Mandiri.

[3] Tjipto, F. (2009). *Manajemen Pengaduan Komplain*. Yogyakarta: Penerbit Andi.

[4] Mursalim, S. W. (2018). Analisis manajemen pengaduan sistem layanan sistem aspirasi pengaduan online rakyat (LAPOR) di Kota Bandung. *Jurnal Ilmu Administrasi: Media Pengembangan Ilmu dan Praktek Administrasi, 15*(1), 1-17.

[5] Mahbub, A. R., Hantoro, K., & Suyanih, Y. (2020). Analisa dan perancangan layanan pengaduan masyarakat desa berbasis web dengan pendekatan UML. *Faktor Exacta, 13*(1), 26-34.

[6] Hidayat, R., & Listianingsih, L. (2018). Perancangan sistem keluhan pelanggan berbasis web E-RCM dengan model Waterfall pada PT. Unggul Cipta Teknologi. *Publikasi Jurnal & Penelitian Teknik Informatika, 2*, 112-118.

[7] Breitsohl, J., Khammash, M., & Griffiths, G. (2010). E-business complaint management: Perceptions and perspectives of online credibility. *Journal of Enterprise Information Management*. https://doi.org/10.1108/17410391011083083

[8] Tax, S. S., Brown, S. W., & Chandrashekaran, M. (1998). Customer evaluations of service complaint experiences: Implications for relationship marketing. *Journal of Marketing, 62*(2), 60-76. https://doi.org/10.1177/002224299806200205

[9] Taleghani, M., Largani, M. S., Gilaninia, S., & Mousavian, S. J. (2011). The role of customer complaints management in consumers' satisfaction for new industrial enterprises of Iran. *International Journal of Business Administration, 2*(3), 140.

[10] Johnston, R., & Mehra, S. (2002). Best-practice complaint management. *Academy of Management Perspectives, 16*(4), 145-154. https://doi.org/10.5465/ame.2002.8951342

[11] Cooper, A., Reimann, R., Cronin, D., & Noessel, C. (2014). *About face: The essentials of interaction design*. John Wiley & Sons.

[12] Sutherland, J., & Coplien, J. O. (2019). *A scrum book: The spirit of the game*. Pragmatic Bookshelf.

[13] Schwaber, K., & Sutherland, J. (2011). *The scrum guide*. Scrum Alliance.

[14] Dwyer, G. (2016). *Flask by example*. Packt Publishing Ltd.

[15] Verma, A., Khatana, A., & Chaudhary, S. (2017). A comparative study of black box testing and white box testing. *International Journal of Computer Science and Engineering, 5*(12), 301-304. https://doi.org/10.26438/ijcse/v5i12.301304

[16] Jan, S. R., Shah, S. T. U., Johar, Z. U., Shah, Y., & Khan, F. (2016). An innovative approach to investigate various software testing techniques and strategies. *International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), 2*(2).

[17] Jordan, P. W. (2020). *An introduction to usability*. CRC Press.

[18] Lund, A. M. (2001). Measuring usability with the USE questionnaire. *Usability Interface, 8*(2), 3-6

[19] Teplická, K., Khouri, S., Mudarri, T., & Freňáková, M. (2023). Improving the quality of automotive components through the effective management of complaints in industry 4.0. Applied Sciences, 13(14), 8402. https://doi.org/10.3390/app13148402.

[20] Pio, P., Sigahi, T., Rampasso, I., Satolo, E., Serafim, M., Quelhas, O., … & Anholon, R. (2023). Complaint management: comparison between traditional and digital banks and the benefits of using management systems for improvement. International Journal of Productivity and Performance Management, 73(4), 1050-1070. https://doi.org/10.1108/ijppm-08-2022-0430.

[21] Susanti, E. (2021). Complaints handling satisfaction mediates between complaints handling to customer loyalty for the indonesian banking industry. International Journal of Digital Entrepreneurship and Business, 2(2). https://doi.org/10.52238/ideb.v2i2.69.

[22] El-Metwally, D. (2013). Complaint handling in the airline industry: the way to enhance customer loyalty. Mediterranean Journal of Social Sciences. https://doi.org/10.5901/mjss.2013.v4n10p299.

