International Journal of Innovation, Creativity and Change. www.ijicc.net
Volume 15, Issue 2, 2021

SITRANS: A Design of Laboratory Management System

Emmy Wahyuningtyas[a], Shofiya Syidada[b], Firman Pratama[c], [a,b,c]Informatic Department, Faculty of Engineering, University of Wijaya Kusuma Surabaya, Surabaya, Indonesia. Email: [a]emmy@uwks.ac.id, [b]shofiya@uwks.ac.id, [c]firmanpratama@uwks.ac.id

The Covid19 pandemic has changed the culture of human civilisation, including in the field of higher education. The learning process has switched to online and requires educational institutions to provide facilities that support the carrying out of online activities for regular and non-lecture courses such as practicum, research, thesis, practical work and real work lectures. At Wijaya Kusuma University, Surabaya, regular lectures have been facilitated by the existence of a moodle-based learning management system (LMS) called Elena, but the implementation and monitoring of non-lecture activities has not been facilitated by online media so there are many obstacles and it is less than optimal. This study aims to design a system to facilitate the management of these activities that is integrated with the institution's integrated e-campus system. The design uses a unified modelling language (UML) which consists of a package diagram, use case, class and sequence diagram. The system is named Transitoris Information System (SITRANS).

Keywords: *Labs Management System, UML, Practical Work, Practicum Management*

Introduction

The Covid19 outbreak that hit almost all parts of the world has changed the way humans live in various ways. The education sector is one of the areas that is directly affected, and there are significant changes in the learning process. Until this paper was written, all levels of education in Indonesia, from pre-school to tertiary education, were still implementing learn from home (LFH) to reduce the rate of transmission of the virus. The World Bank reported that 530 thousand education units in Indonesia were closed due to the Covid19 outbreak. For this reason the presence of an information technology-based education platform is needed as a concrete response to reduce the loss of academic learning time (Yarrow, et al., 2020). Yet the American Enterprise Institute (AEI) reports digital learning will become more ubiquitous out of necessity but will likely not be the preferred choice of most undergraduate students. To reinforce distance

learning, institutions must provide virtually strong student support, which will require creative thinking and reallocation of resources and staff (Kelly & Columbus, 2020). Most, but not all, students have access to digital tools that can be used for online learning (as shown in Table 1). Institutions should be prepared to provide accommodation for students who do not have access to devices at all or do not have devices that are compatible with the institution's LMS. Access varies greatly by type of institution (Brooks & Grajek, 2020). The percentage of students using LMS is shown in Table 2.

Table 1 Device Access Among Community College and Four-Year Students

Device	Community college students	Four-year students
Smartphone	96.3%	97.9%
Laptop	89.8%	92.2%
Tablet	44.8%	33.5%
Desktop	44.4%	30.8%
Hybrid or 2-in-1 device (e.g., Lenovo Yoga, Microsoft Surface)	10.4%	11.3%

Table 2 Students' LMS use

Students who used the LMS for...	Percentage
All of their courses	68.3%
Most of their courses	21.2%
About half of their courses	4.5%
At least one of their courses	2.6%
None of their courses	3.4%

Universitas Wijaya Kusuma Surabaya as one of the higher education providers in Indonesia always responds quickly to environmental situations and conditions, as well as the government's appeal through the Ministry of Education and Culture of the Republic of Indonesia (Kemdikbud RI) to carry out online learning.

An online learning platform is available and continues to be developed by presenting new features to support the needs of lecture activities. This online learning platform named Elena has been well managed so that it can accommodate the needs of all lecturers and students. LMS is very important for students regarding their daily assignments so that lecturers can more easily reach students outside of class hours related to assignments and learning materials (Adzharuddin & Ling, 2013).

However, the learning process is not only through lectures, there are also non-lecture activities such as practicum, field work practices, and theses that are no less important in supporting the learning process. This non-lecture activity has not been managed optimally so that during the LFH period, lecturers and students experienced problems such as difficulty in validating participant data, lack of a simple payment processes and difficulty monitoring activities and reporting processes for non-lecture activities, all of which were still manual causing the implementation to be inefficient.

This study aims to design a system that is expected to facilitate the entire management of non-college academic activities that are integrated with the institution's integrated e-campus system. This design uses a unified modelling language (UML) which consists of a package diagram, use case and class diagram. The system, which is named Transitoris Information System (SITRANS), consists of several sub-systems, namely the registration sub-system, the laboratory management sub-system, the practicum and assignment sub-system, the practical work sub-system, the thesis / final project sub-system, and the real work lecture sub-system (KKN).

Literature review

Academic Activities in Higher Education

In general, there are two types of academic activities in tertiary institutions, namely intra-curricular and extracurricular activities. Intra-curricular activities are regular academic activities that must be followed by students who have been designed based on the applicable curriculum (Santoso, 2015). Meanwhile, Correa-Fernandes (2015) in their study report stated that in general the involvement of extracurricular activities is part of the college experience and strengthens the relationship between students and their institutions. Wijaya Kusuma University, Surabaya is known for transitory activities, which are non-lecture academic activities that must be taken by every student other than regular courses.

Laboratory functions

Activities and experiments in the laboratory often accompany the lecture and discussion sections of science courses. Universities often have separate laboratory sections for students, in addition to a lecture section (Forcino, 2013). Meanwhile, other literature states that the engineering laboratory is a technical instrument of teaching. The continuity of classroom learning theory will be applied in the laboratory for understanding and exposure to technical skills (Mohamad, et al., 2012). In his study, Aiyan (2017) states that practical teaching is an effective way to consolidate and deepen the study of theoretical knowledge, that it is an important link to cultivate innovative high-quality technical and technical personnel, is an important platform for theory by practice, trains students to master the method scientific and that it improves practice abilities.

Laboratory Management

Laboratory management is a very important element during the teaching and learning process, especially in terms of practical work for engineering students (Mohamad, et al., 2012). In other sources it is stated that the laboratory is an important element and one of the requirements for the existence of a university. It needs to be managed properly in order to carry out the functions of the Tri Dharma of Higher Education (Asmoro, et al., 2019). In terms of operation, the laboratory is managed by the head of the laboratory who is assisted by several assistants. The role of an assistant as a direct technical assistant for the practitioners during the lab session is as stated by Utekar, et al., (2020), that a teacher cannot supervise the entire lab and control student activities at all times during practical sessions. The biggest challenge is enabling students to take advantage of learning technology while keeping the classroom productive and well-managed. In addition, in this study, an architectural design for a lab management system is proposed as shown in Figure 1.

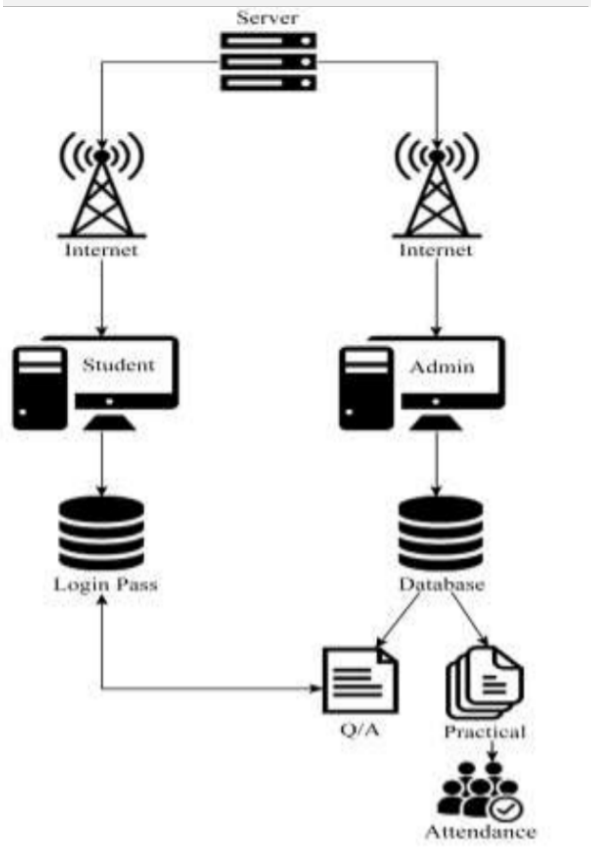

Figure 1 Lab Management System Architecture (Utekar, et al., 2020)

In order to create a safe and comfortable laboratory environment for all lab users, a conducive situation must be maintained and laboratory management staff must regularly organise, maintain and update the work culture environment in the laboratory (Aiyan, 2017).

Object Based System Design

The development of object-oriented programming language gives rise to a new approach that in order to develop object-based information systems, it is advisable to carry out object-oriented analysis and design. Many proponents of the object-oriented approach claim (with non-substantial evidence) that it is better to start a system analysis by determining the structure of its objects than by defining its function.

Object-oriented analysis and design is a technical process for the specific manipulation of an application, business model or system, and simple graphic diagrams to analyse and design by applying the object-oriented prototype method (Castagna, 2012). Object-oriented analysis (OOA) is basically a collection of system models that combines various requirements and pre- and post-analysis methodologies for software systems. Object-oriented modelling is used at the beginning of the software life cycle to develop domain property, requirements, and specifications. This involves the following steps (Al-Fedaghi, 2018):

a. Represent people, physical things, and concepts that are important to our understanding of what is going on in the application domain.
b. Show connections and interactions among these people, things, and concepts.
c. Show the business situation with enough detail to evaluate possible designs.
d. Check whether the functions we will include in the specifications will satisfy the requirements, and test our understanding of how the new system will interact with the world

Unified Modelling Language (UML)

UML, short for Unified Modelling Language, is a standardised modelling language consisting of an integrated set of diagrams, developed to help system and software developers for specifying, visualising, constructing, and documenting the artifacts of software systems, as well as for business modelling and other non-software systems (Anon., n.d.). Another website (Anon., n.d.) says that UML is a standard modelling language, not a software development process. UML 1.4.2 Specification explained that process:

a. provides guidance as to the order of a team's activities,
b. specifies what artifacts should be developed,
c. directs the tasks of individual developers and the team as a whole, and
d. offers criteria for monitoring and measuring a project's products and activities.

Methodology

The stage in this research is to collect data through interviews with the heads of the lab and lab assistants. Observations were made to see the process of implementing the practicum running for 1 practicum period for 4 practicum subjects. Document review is carried out to obtain various forms of documentation of activities from the beginning to the end of the practicum period related to attendance, assignment of assistants and monitoring of activities and reporting of practicum results. Researchers take part in the integration of transitory (non-college) activities with the academic system which includes participant registration, payment, data verification, monitoring, reporting and assessment. The types of transitory activities at Wijaya Kusuma University, Surabaya are grouped as in Table 3.

Table 3 Non-Lecture Activities

	Type of activity	Description
1	Practical work	Practical activities in the campus laboratory
2	Course assignments	Activities that are attached to certain courses but held outside the classroom
3	Field Work Practices (PKL) / Job Training (KP)	Activities to apply science in the real industrial field
4	Final Project / Thesis	Student research activities at the end of the study period
5	Community Service Program (CSP)	Student personality development activities include hard skills and soft skills. Performed off campus

Furthermore, the authors conducted a functional requirements analysis and designed a business process to produce a more detailed picture of how all activities are carried out by each entity, designed using an activity diagram. The system design is continued using UML, as well as an interface design, is made based on the results from the generated diagrams.

Proposed Design

Package Diagram

The SITRANS system consists of a sub-system for managing laboratories, practicum and assignments, practical work, final assignments and Community Service Program (CSP). Practicum sub-system and assignments are part of the laboratory management sub-system.

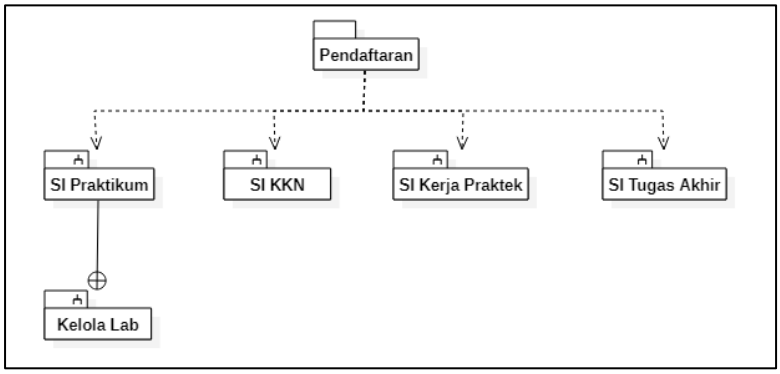

Figure 2 Package Diagram of SITRANS

The main system of SITRANS consists of 4 main sub-systems, namely (i) a sub-system run by practicum, (ii) a sub-system managed by KKN, (iii) a sub-system that is managed by practice and (iv) a sub-system that is finalised. In the system practice there is a laboratory management

module. The interaction relationship between SITRANS and its environment is shown in the use case diagram in Figure 3.

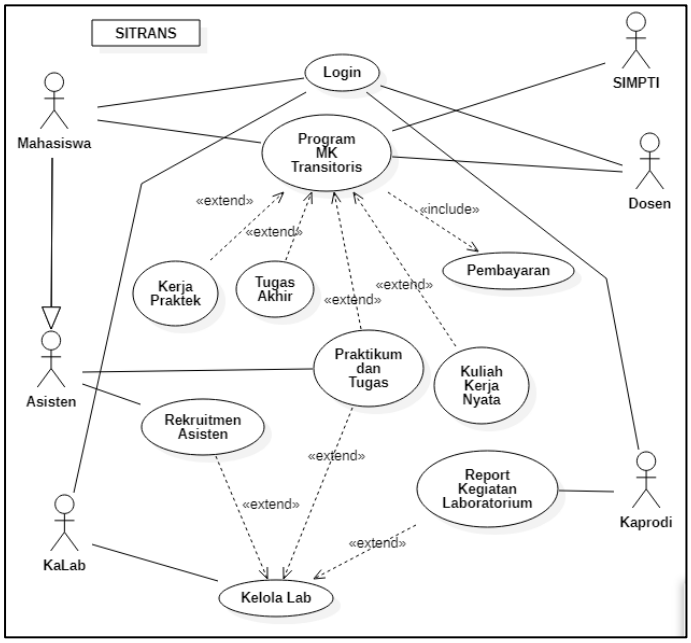

Figure 3 Use Case Diagram of SITRANS

There are 10 use cases and 6 actors in SITRANS. A login is required for each user, both practical students and assistants and lecturers. In the case of transitoric MK, students can choose the type of transitory MK provided by the study program, then MK participants are required to make payments. Before practicum and assignments can be carried out, it is necessary to recruit lab assistants to help the lab head and lecturers to accompany the practitioner during the practicum until the end of the semester. In the case of laboratory management, the head of the laboratory is given a feature to report practicum activities which is then reported to the head of the study program.

Furthermore, a class diagram is made to describe the relationship between classes that will be built in SITRANS and its sub-systems. Figure 4 is a class diagram for SITRANS which consists of 17 classes and their relationships. This class diagram helps system developers to translate the data model schema and the relationships between classes that must be built.

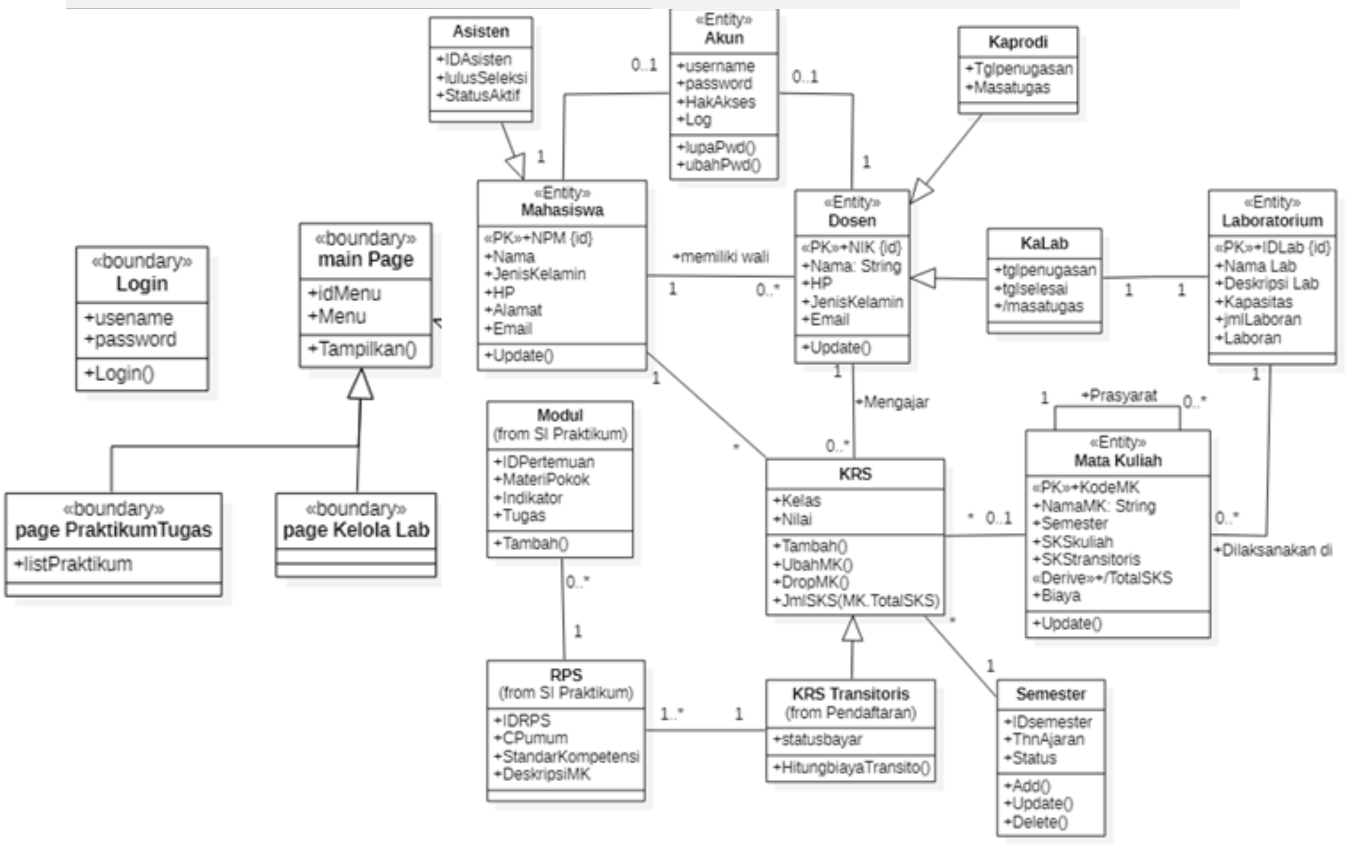

Figure 4 Class Diagram of SITRANS

One of the important sub-systems in SITRANS is lab management which includes the management of various activities including research, practicum and assignments, recruitment of lab assistants, lab administration and reporting of lab activities. The interactions that occur in the manage lab sub-system are visualised using the use case diagram in Figure 5.

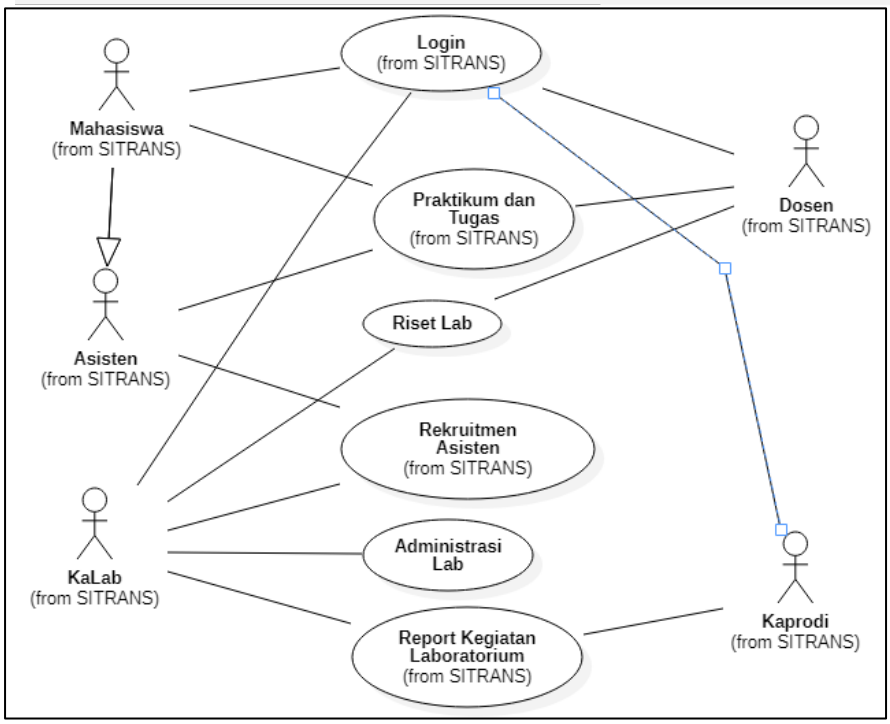

Figure 5 Use Case Diagram of Lab Management

The research sub-system as part of the lab management is a module designed to facilitate the research activities of lecturers and students under certain laboratories. It includes research planning activities, research team selection, research progress monitoring and reporting. An overview of the sequence of research activities is shown by the activity diagram in Figure 6.

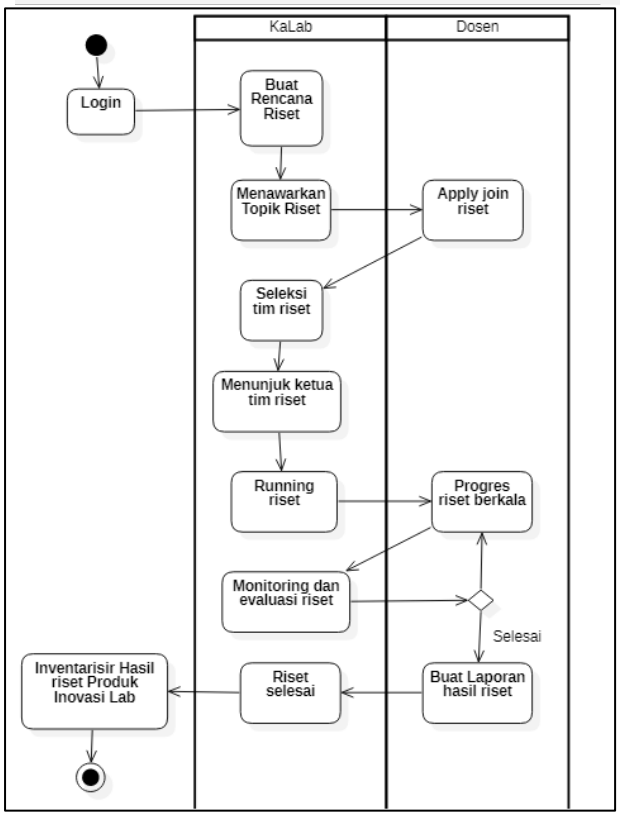

Figure 6 Activity Diagram of Research Sub System

The practicum and assignment sub system is an important part of SITRANS which contains modules for managing practicum activities. Figure 7 visualises cases that occur in practicum activities that involve 4 actors in their interactions with 5 existing cases, namely login, practicum setup, schedule, practicum monitoring and grade entry.

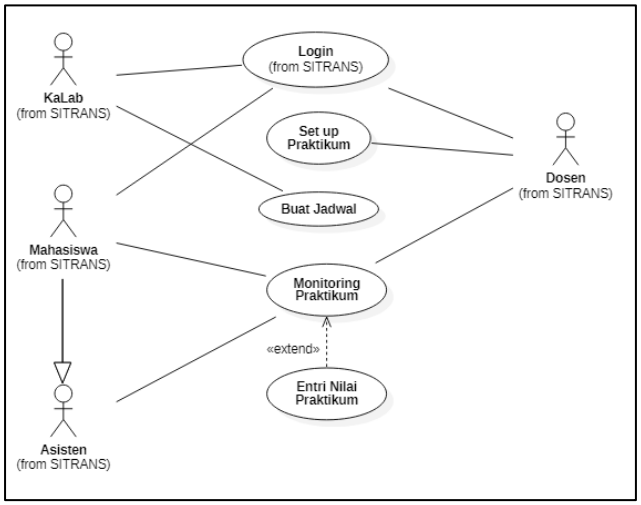

Figure 7 Use Case Diagram of Practicum and Assignment Sub System

Each use case scenario is described in detail in Tables 4, 5 and 6.

Table 4 Use Case Scenario of practical work initial setup

USE CASE NAME:	**SET UP PRAKTIKUM**	**UNIQUE ID :**
AREA:	SITRANS	
ACTOR(S):	Lecturer	
DESCRIPTION:	Preparing the transitoris practicum MK which will be carried out in the current semester which includes filling out the RPS and practicum modules	
TRIGGERING EVENT:	at the beginning of the semester	
TRIGGER TYPE:	External	Temporal
STEP PERFORMED (MAIN PATH)		**Information for Steps**
1. DOSEN LOGIN PADA SUB SYSTEM PRAKTIKUM		Username, password, lecturer access rights
2. DOSEN MEMILIH PRAKTIKUM YANG AKAN DIBUAT RPS DAN MODULNYA		Practical data for the current semester
3. DOSEN MEMBUAT RPS		Practicum data
4. DOSEN MEMBUAT MODUL		Practical data material
PRECONDITIONS:	Practical data opened in the current semester has been determined	
POSTCONDITIONS:	Each practicum opened has a RPS and a practicum module	
ASSUMPTIONS:	Each practicum has been assigned a supervisor	
REQUIREMENT MET:	Lecturers make RPS and practicum modules	
OUTSTANDING ISSUES:		
PRIORITY:	High	
RISK:	High	

Table 5 Use Case Scenario of practical work scheduling

USE CASE NAME:	**BUAT JADWAL PRAKTIKUM**	**UNIQUEID :**
AREA:	SITRANS	
ACTOR(S):	Head of Lab	
DESCRIPTION:	Make a schedule for practicum implementation carried out by the laboratory	
TRIGGERING EVENT:	at the beginning of the semester	
TRIGGER TYPE:	External Temporal	
STEP PERFORMED (MAIN PATH)		**Information for Steps**
1. KALAB LOGIN PADA SUB SYSTEM PRAKTIKUM		Username, password, Head of Lab access rights
2. KALAB MELIHAT JUMLAH DATA PESERTA PER KELAS		Practicum participant data per class
3. KALAB MEMBAGI SESSI PRAKTIKUM		Practicum participant data, laboratory capacity
4. KALAB MEMBAGI PESERTA PRAKTIKUM SESUAI DENGAN SESSI YANG TERSEDIA		Practicum session data
5. KALAB MEMBUAT JADWAL SESSI PER MODUL PRAKTIKUM BERDASARKAN WAKTU SERTA ASISTEN YANG TERSEDIA		Session data, assistant
6. SYSTEM MEMERIKSA KETERSEDIAAN JADWAL PRAKTIKUM		Practical schedule data
PRECONDITIONS:	Practicum participant data opened in the current semester has been determined	
POSTCONDITIONS:	Practical schedule per session per module is available	
ASSUMPTIONS:	Each practicum has been assigned a supervisor	
REQUIREMENT MET:	Lecturers make RPS and practicum modules	
OUTSTANDING ISSUES:		
PRIORITY:	High	
RISK:	High	

Table 6 Use Case Scenario of practical work monitoring

USE CASE NAME:	MONITORING PRAKTIKUM	UNIQUE ID :
AREA:	SITRANS	
ACTOR(S):	Students, Assistants, lecturers	
DESCRIPTION:	Monitoring the implementation of practicum which includes the presence of students in practicum, processing and submitting assignments per module, guidance and assistant assessment of practicum results reports, and recapitulation of student practicum scores at the end of the semester	
TRIGGERING EVENT:	During lab session	
TRIGGER TYPE:	External	Temporal

STEP PERFORMED (MAIN PATH)	Information for Steps
1. MAHASISWA LOGIN PADA SUB SYSTEM PRAKTIKUM	Username, password, student access rights
2. MAHASISWA MELIHAT PRAKTIKUM YANG DIIKUTI	Practical data followed
3. MAHASISWA MENGISI PRESENSI KEHADIRAN	Session data
4. MAHASISWA MENGERJAKAN TUGAS MODUL YANG DIBERIKAN	Module data
5. MAHASISWA MENGUMPULKAN TUGAS DAN LAPORAN HASIL PRAKTIKUM	Module assignment data
6. ASISTEN MEMERIKSA LAPORAN HASIL PRAKTIKUM DAN MEMBERIKAN NILAI	Practical report data
7. DOSEN MEMERIKSA TUGAS, LAPORAN HASIL PRAKTIKUM SERTA PENILAIAN DARI ASISTEN	Data reports on practicum results, grades
8. DOSEN MELAKUKAN REKAPITULASI NILAI PRAKTIKUM MAHASISWA	Grade
9. DOSEN MEMBUAT LAPORAN NILAI PRAKTIKUM	Grade

PRECONDITIONS:	Practical implementation
POSTCONDITIONS:	Students get grades from the practicum that is followed
ASSUMPTIONS:	Students take part in practicum activities from beginning to end
REQUIREMENT MET:	Documentation of practicum activities is well recorded
OUTSTANDING ISSUES:	
PRIORITY:	High
RISK:	High

Table 7 Use Case Scenario of Grading

USE CASE NAME:	GRADING	UNIQUE ID :
AREA:	SITRANS	
ACTOR(S):	Assistant and lecturer	
DESCRIPTION:	Entry scores are part of the monitoring process of practicum implementation, where the Assistant provides an assessment of the results of student work in completing the practical module assignments and the final assessment of the practicum given by the lecturer based on the recapitulation of scores obtained by students.	
TRIGGERING EVENT:	Completion of practicum module assignments	
TRIGGER TYPE:	External	Temporal
STEP PERFORMED (MAIN PATH)		Information for Steps
1. ASISTEN LOGIN PADA SUB SYSTEM PRAKTIKUM		Username, password, Assistant permissions
2. ASISTEN MEMERIKSA HASIL PENYELESAIAN TUGAS MODUL MAHASISWA		Student module assignment data files
3. ASISTEN MEMBERI NILAI		Student module assignment data files
4. ASISTEN MEMBERIKAN CATATAN KOREKSI, BILA ADA YANG HARUS DIPERBAIKI MAHASISWA. SETELAH MAHASISWA MEREVISI TUGASNYA, ASISTEN MEMBERIKAN NILAI KEMBALI		Correction record data
5. DOSEN MELIHAT NILAI YANG TELAH DIBERIKAN ASISTEN DAN MELIHAT TUGAS MAHASISWA		Module assignment grade data
6. DI AKHIR SEMESTER, DOSEN MELIHAT SELURUH NILAI TUGAS MAHASISWA PADA SETIAP MODUL		List of all module assignments
7. DOSEN MELAKUKAN REKAPITULASI DAN MEMBERIKAN NILAI AKHIR PRAKTIKUM		grade list data
PRECONDITIONS:	Students have completed module assignments	
POSTCONDITIONS:	Students get the value of each assignment and the final score of the practicum	
ASSUMPTIONS:	Students complete assignments for each module	
REQUIREMENT MET:	The assistant provides an assessment for each task	
OUTSTANDING ISSUES:		
PRIORITY:	High	
RISK:	High	

The class diagrams for the practicum and assignment sub-systems are shown in Figure 8. A total of 17 object classes must be built for this module, and the relationships that occur between classes are listed to describe the data model.

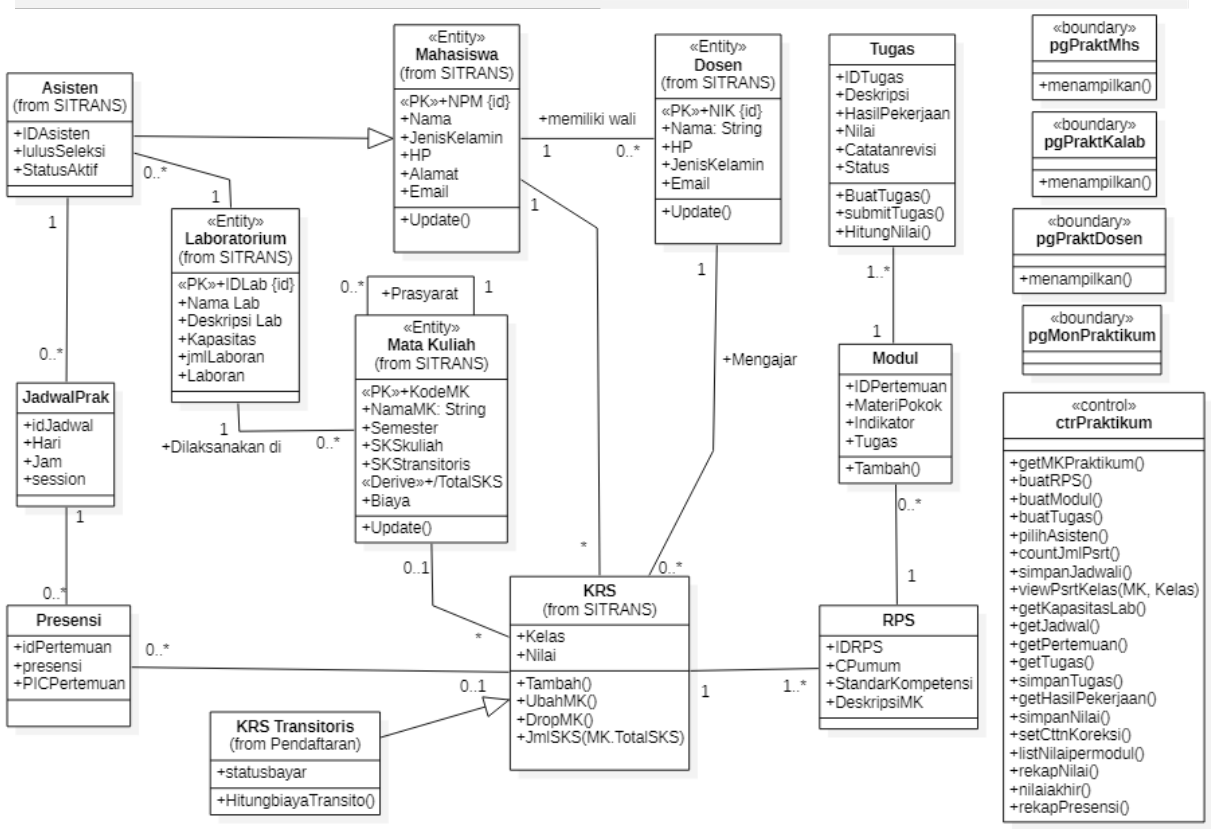

Figure 8 Class Diagram of Practical work module

The recruitment of assistants is no less important in SITRANS. A good recruitment process that meets certain standards will result in selected assistants who are competent and qualified.

User interface

Login Module and Password Recovery

The following are some of the SITRANS interface designs, including login page and password recovery (Figure 9), placement of menus on the system dashboard (Figure 10). The rest are an interface for joining the research group (Figure 11) and a page to monitor the progress of the research (Figure 11).

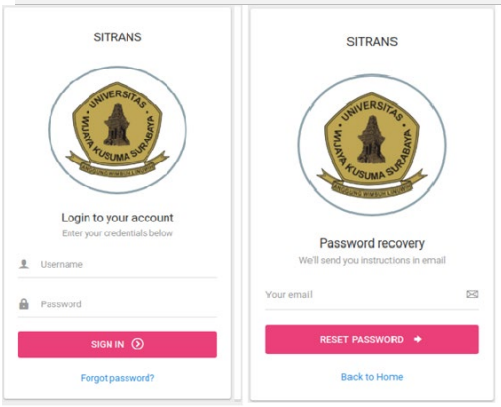

Figure 9 Login Page

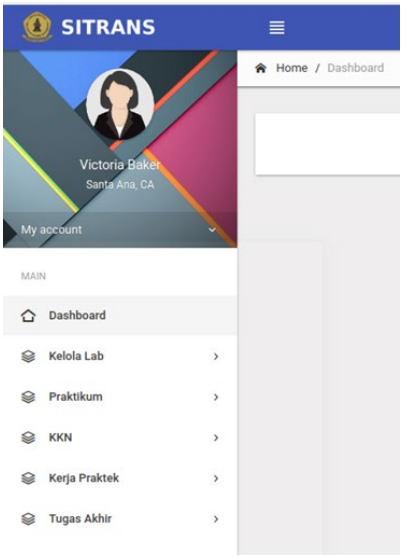

Figure 10 System Dashboard

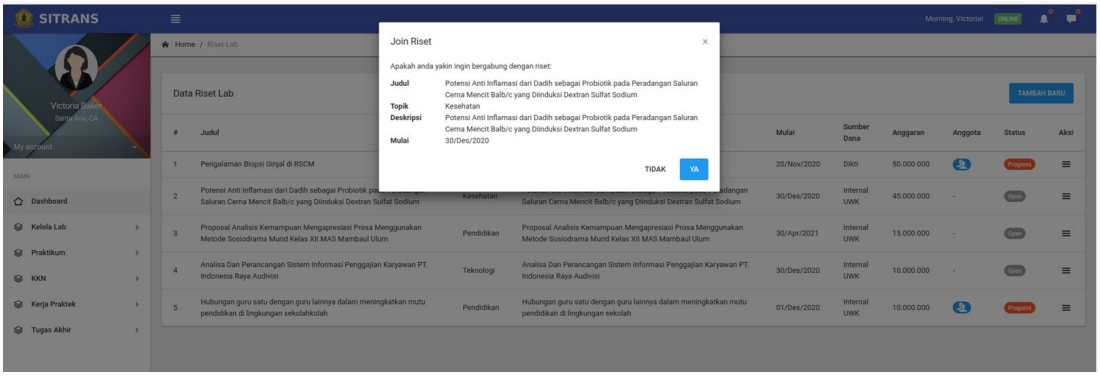

Figure 11 Join a Research Page

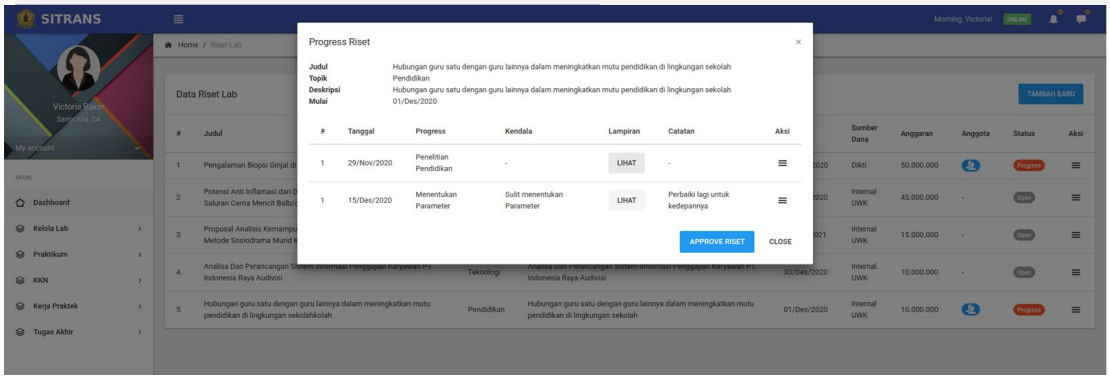

Figure 12 Research Approval Page

Conclusions

In this study, a system was designed to manage all non-lecturing academic activities, especially those carried out in the laboratory as one of the study centres on campus. The design of use case diagrams and their scenarios, class diagrams and activity diagrams has been obtained for each module in SITRANS. The authors hope that the results of this study will be useful as a reference for institutions to carry out system development, so that the management of non-college academic activities can be optimally organised and monitored online, especially during the Covid19 pandemic which has not ended. Further study is needed to design practical work modules, theses and real work lectures so that a comprehensive and integrated design will be obtained with the academic system that has been settled.

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