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Designing a Payroll System Database for Staff of the Informatics Engineering Department of Universitas Muhammadiyah Yogyakarta

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Abstract

The development of a staff payroll system aims to create a system that can help an administrator recapitulate attendance and payroll data of Informatics Engineering (IE) Department staff quickly and accurately. Such a development requires a database. The database design is divided into four stages: requirement collection and analysis, conceptual database design, logical database design, and physical database design. Design testing was performed on the database by testing the access policies, anomaly check, and view check. The results reveal that the proposed system worked well did not encounter anomalies.

Keywords: *payroll system, access policies, anomaly check, view check.*

1. Introduction

Universitas Muhammadiyah Yogyakarta (UMY) is one of the private universities in Yogyakarta, with several faculties such as Islam Studies, Social and Political Sciences, Language Education, Economics, Law, Agriculture, Engineering, as well as Medicine and Health Sciences. Each faculty has a different method of payroll system for lecturers, assistant lecturers, and other staff. The Department of Informatics Engineering at the Faculty of Engineering UMY has a manual payroll system, resulting in an ineffective and inefficient performance. Recently, for data processing, Microsoft Office Excel is still used by the management to make calculations, especially for staff payroll. The payroll system requires inputting data of attendance lists, courses, and classes taught per day, especially for lecturers and assistant lecturers. However, it could cause data loss or errors in calculations, missing information, leading to a lack of accuracy of the payroll system.

A study entitled Database Design of a Payroll Information System (Case Study at 'XYZ' University) designed a database to assist the software development section in creating a payroll information system and facilitate the financial department in managing the payroll data to easily obtain the required information. This research aims to create a database design scheme for the payroll information system at "XYZ" University. It applied a conceptual database design (conceptual scheme design), an entity-relationship diagram (ERD) design, a logical database design called a relational database design, and a physical database design (physical design)—the design of storage structures and access points in database files [1]. Meanwhile, the research entitled Database Design for the Development of a Web-

Based Academic Information System of the Information Technology Department of Politeknik Padang designed a database that could meet the needs of the academic information system of the department [2]. The study aimed to design a database to meet the needs of the Information Technology Department's academic information system to become a more integrated system, with broader user access and following the I/O format and procedures of the implemented academic system. The design method utilized the logic database design, ER modeling (conceptual design), integration of ER models from various user views, a transformation of ER models into SQL tables, and normalization of SQL tables (up to the third form or BCNF). Furthermore, physical database design was carried out by selecting index (access method) and clustering. In addition, a study entitled Implementation of a Database System to Support the Development of a Human Resource Management Information System (Case Study: STIKOM Dinamika Bangsa) focused on implementing database design into an integrated database system connecting all functions in HR Management [3]. The study aimed to analyze the data structure in the database design and make adjustments according to implementation needs. The design method employed a conceptual database schema developed by making adjustments to the needs of the database management system (DBMS) to be used, designing database transactions, and implementing the database system.

Considering above weaknesses supported by [4-6], a web-based payroll information system for IE staff was created, aiming to simplify the recapitulation of IE staff payroll data quickly and accurately. This study aims to design and implement a database on the payroll system of IE staff. The database can support the administrator to use and manage the data. The data are in the form of some information about lecturers, instructors, assistant lecturers, courses, classes, and attendance. This information system is expected to facilitate the monthly payroll process. Thus, the calculation of salaries and salary data recapitulation of IE staff will not take a long time and minimize human error.

The remainder of this paper is organized as follows. Section II reviews the methods while Section III elaborates in detail the experimental results. Finally, Section IV summarizes the conclusion.

2. Method

Figure 1 shows the database design method i.e., included four stages: analysis and requirements gathering, conceptual database design, logical database design and physical database design.

2.1 Analysis and Requirements Gathering

Analysis and requirements gathering are collecting and analyzing information used to identify user needs on a system [7], [8]. The collected information can be in the form of existing documentation reviews or interviews with several users associated with the system.

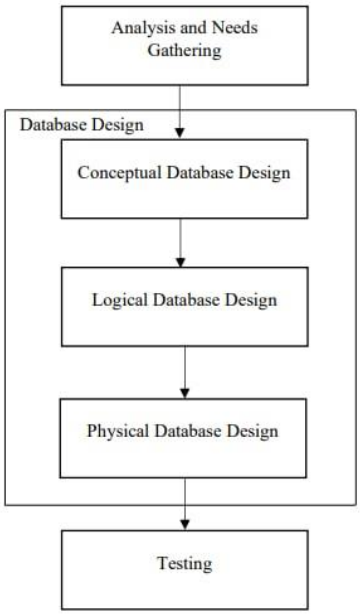

Figure 1. Database Design Stages

2.2 Interview

An interview offers a potentially valuable but often neglected or untrusted source of evidence in investigating a phenomenon [9]. Within an interview, the following problems and decisions must be addressed: (1) who will be interviewed; (2) when to stop the specific interview; (3) place for interview; (4) which questions will be asked; and (5) how the data will be collected [10]. In this study, the interviews were performed through direct questions and answers to the interviewees. The interviews were conducted with three people involved in the payroll department. Two of them managed the staff attendance, and the other one dealt with payroll accounting. Interviews were conducted to obtain information about the old attendance system and features required for the website development.

- **Documentation**

The documentation stage is the stage of collecting data from observations of objects in recapitulating financial data, references collected from files and the results of observations combined to obtain all information used to create the system.

- **Conceptual Database Design**

Conceptual database design builds a model based on the information used by a company or organization without physical planning considerations. Designing a conceptual database involves several steps: identifying the entity, identifying the attributes of the entity, determining the primary key, and identifying the relationship between one entity and another.

- **Normalization**

The normalization stage was carried out to check the tables and correct them (normalization) [8], [9]. The normalization aims to:

a. Eliminate duplicate data to impact memory waste
b. Reduce complexity
c. Make it easy to modify data
d. Avoid anomalies (data inconsistency)

Normalization is a formal technique applicable in database design. The role of normalization, in this case, is the use of a bottom-up approach as a validation technique to examine the structure of the relationship. Normalization within this study was conducted to improve the unfavorable table design so that data storage became more efficient and free from data anomalies. To clarify understanding of the normalization process, the following diagram must be considered:

Figure 2. Normalization Process

- **Logical Database Design**

Logical database design is a stage to map the conceptual design process into a database model, from the entity-relationship diagram (ERD) to table form [10]. The database design utilized a relationship model.

- **Physical Database Design**

Physical database design is a process to produce an overview of the database implementation in a storage area, organize files and indexes used for data efficiency, link integrity constraints, and provide user access restrictions.

- **Access Policy**

Access policy is a step given to provide access restrictions to users. The access policies for multiple users are as follows:

a. Administrator Access Policy

1. Login, view, add and change data in the administrator table
2. View, add, modify, delete staff data
3. View, add, change, delete course data
4. View and change staff status data
5. View, add, change, delete class data
6. View, add, change, delete attendance data
7. View, add, modify, delete payroll data

b. Staff Access Policy

1. Login
2. View and change passwords
3. View payroll data

c. Master Access Policy

The master has full rights to the database and can view, add, modify, and delete data in the staff payroll system database.

2.3 Testing

The test methods used in developing this database are anomaly testing and view check. Anomaly testing and view check were performed through the administrator page. Anomaly testing was used to determine whether the database process gave unexpected side effects. For example, it caused inconsistent data or data loss when the data were deleted, and view check functioned to validate data.

3. Results

3.1. Testing

3.1.1 Testing Method

Software testing was carried out to obtain information and evaluate the quality of the product or service tested. This database development test determined whether the database could meet the needs of the administrator and users based on software design and development. Following are the results of the anomaly and the view check testing.

3.1.2 Testing Method

Anomaly testing was carried out on tables that had relationships from one table to another. Tests were carried out three times, consisting of insertion, deletion and update anomalies.

a. Anomaly Testing on the User Table

1. Insertion anomaly

The insertion anomaly was performed on the user table because it had a relationship with the administrator and staff tables. The insertion anomaly testing is displayed in Table 1.

Tabel 1. Insertion Testing on the User Table

User Table

id_user	role
1	Admin
2	Staff
3	TU

Administrator Table

id_admin	id_user	email_admin	password_admin
4545	1	adminnie@gmail.com	098f6bcd4621d373cade4e832627b4f6
4546	1	nadyaaprillia@gmail.com	babd26213f50f2906fae75698e24d1c1
4547	1	hartikarahay@gmail.com	0c14e488a51a54689d0f8a9d2000c5ff
4548	1	nisrinaarp@gmail.com	d7f51cb5be62883c3570409bba87bc64
4549	3	budi@gmail.com	750462c088103c9632e5a746a4b0dba5

Staff Table

nip	id_user	nama_staff	status	alamat_staff	nohp_staff	email_staff	password_staff
A01	2	Ohno Satoshi	Asisten	Tokyo	934567891	satoshiohno@yahoo.jp	7c978c1228b60cc41787020695ff8cb77
A02	2	Ninomiya Kazunari	Asisten	Tokyo	86523456890	ninomiyakazunari@yahoo.jp	d5433b40b38af99be049364c502c88dd
D01	2	Aprillia Kurniati	Dosen	Jalan Magelang	987654322123	aprilliakurniati@gmail.com	e4b3a0f4e7348df27ce5b124c09f01ac
D02	2	Slamet Riyadi	Dosen	Yogyakarta	87654323678	slametriyadi@gmail.com	92a968ca99da34abeeb3f2042f973cab
I01	2	Sakurai Sho	Instruktur	Tokyo, Japan	975367112	sakuraisho@yahoo.jp	6ec28e0d3a75899f36a7b7c56bac3eec
I02	2	Matshumoto Jun	Instruktur	Japan	23456789098	matshumotojun@yahoo.jp	ce5ec93770844b25ef0223b169a2f08a

After inserting data into the user table, there was no change in the administrator and staff tables, indicating no anomaly in data entry.

2. Update anomaly

An update anomaly testing was performed on the user table as it was related to the administrator and staff tables. The update anomaly testing is presented in Table 2.

Table 2. Update Testing on the User Table

User Table

id_user	role
12	Admin
22	Staff
33	TU

Administrator Table

id_admin	id_user	email_admin	password_admin
4545	11	adminnie@gmail.com	098f6bcd4621d373cade4e832627b4f6
4546	11	nadyaaprillia@gmail.com	babd26213f50f2906fae75698e24d1c1
4547	11	hartikarahay@gmail.com	0c14e488a51a54689d0f8a9d2000c5ff
4548	11	nisrinaarp@gmail.com	d7f51cb5be62883c3570409bba87bc64
4549	33	budi@gmail.com	750462c088103c9632e5a746a4b0dba5

Staff Table

nip	id_user	nama_staff	status	alamat_staff	nohp_staff	email_staff	password_staff
A01	22	Ohno Satoshi	Asisten	Tokyo	934567891	satoshiohno@yahoo.jp	7c978c1228b60cc41787020695f8cb77
A02	22	Ninomiya Kazunari	Asisten	Tokyo	86523456890	ninomiyakazunari@yahoo.jp	d5433b40b38af99be049364c502c88dd
D01	22	Aprillia Kurniati	Dosen	Jalan Magelang	987654322123	aprilliakurniati@gmail.com	e4b3a0f4e7348df27ce5b124c09f01ac
D02	22	Slamet Riyadi	Dosen	Yogyakarta	87654323678	slametriyadi@gmail.com	92a968ca99da34abeeb3f2042f973cab
I01	22	Sakurai Sho	Instruktur	Tokyo, Japan	975367112	sakuraisho@yahoo.jp	6ec28e0d3a75899f36a7b7c56bac3eec
I02	22	Matshumoto Jun	Instruktur	Japan	23456789098	matshumotojun@yahoo.jp	ce5ec93770844b25ef0223b169a2f08a

After updating the user table data, tables with the same data changed following the updated data, implying no anomaly when the data were updated.

3. Deletion anomaly

A deletion anomaly testing was conducted on the user table since it had a relationship with the administrator and staff tables. Table 3 depicts the deletion anomaly testing.

Table 3. Deletion Testing on the User Table

User Table

id_user	role
1	Admin
2	Staff

Administrator Table

id_admin	id_user	email_admin	password_admin
4545	11	adminnie@gmail.com	098f6bcd4621d373cade4e832627b4f6
4546	11	nadyaaprillia@gmail.com	babd26213f50f2906fae75698e24d1c1
4547	11	hartikarahay@gmail.com	0c14e488a51a54689d0f8a9d2000c5ff
4548	11	nisrinaarp@gmail.com	d7f51cb5be62883c3570409bba87bc64

Staff Table

nip	id_user	nama_staff	status	alamat_staff	nohp_staff	email_staff	password_staff
A01	22	Ohno Satoshi	Asisten	Tokyo	934567891	satoshiohno@yahoo.jp	7c978c1228b60cc41787020695f8cb77
A02	22	Ninomiya Kazunari	Asisten	Tokyo	86523456890	ninomiyakazunari@yahoo.jp	d5433b40b38af99be049364c502c88dd
D01	22	Aprillia Kurniati	Dosen	Jalan Magelang	987654322123	aprilliakurniati@gmail.com	e4b3a0f4e7348df27ce5b124c09f01ac
D02	22	Slamet Riyadi	Dosen	Yogyakarta	87654323678	slametriyadi@gmail.com	92a968ca99da34abeeb3f2042f973cab
I01	22	Sakurai Sho	Instruktur	Tokyo, Japan	975367112	sakuraisho@yahoo.jp	6ec28e0d3a75899f36a7b7c56bac3eec
I02	22	Matshumoto Jun	Instruktur	Japan	23456789098	matshumotojun@yahoo.jp	ce5ec93770844b25ef0223b169a2f08a

After deleting one of the data from the user table, the data from the administrator and staff tables could be deleted. Deleted data in the administrator table 76 and staff table were only data with a relationship with the deleted data in the user table, signifying no anomaly when the data were deleted.

b. Anomaly Testing on the Staff Table

1. Insertion anomaly

Insertion anomaly testing was carried out on the staff table since it was related to the attendance and payroll tables. The insertion anomaly testing is displayed in Table 4.

Table 4. Insertion Testing on the Staff Table

Staff Table

nip	id_user	nama_staff	status	alamat_staff	nohp_staff	email_staff	password_staff
A01	2	Ohno Satoshi	Asisten	Tokyo	934567891	satoshiohno@yahoo.jp	7c978c1228b60cc41787020695f8cb77
A02	2	Ninomiya Kazunari	Asisten	Tokyo	86523456890	ninomiyakazunari@yahoo.jp	d5433b40b38af99be049364c502c88dd
D01	2	Aprillia Kurniati	Dosen	Jalan Magelang	987654322123	aprilliakurniati@gmail.com	e4b3a0f4e7348df27ce5b124c09f01ac
D02	2	Slamet Riyadi	Dosen	Yogyakarta	87654323678	slametriyadi@gmail.com	92a968ca99da34abeeb3f2042f973cab
I01	2	Sakurai Sho	Instruktur	Tokyo, Japan	975367112	sakuraisho@yahoo.jp	6ec28e0d3a75899f36a7b7c56bac3eec
I02	2	Matshumoto Jun	Instruktur	Japan	23456789098	matshumotojun@yahoo.jp	ce5ec93770844b25ef0223b169a2f08a

Attendance Table

id_presensi	tanggal	status	nip	kodeMK	id_kelas	sesi	kehadiran
1	2017-12-04	Dosen	D01	TI-102	3	1	1
2	2017-12-11	Dosen	D01	TI-102	3	2	1
3	2017-12-18	Dosen	D02	TI-101	1	1	1
4	2017-12-26	Dosen	D02	TI-101	1	1	1
5	2017-11-01	Instruktur	I01	TI-105	2	1	1
6	2017-11-01	Instruktur	I01	TI-105	2	2	1
7	2017-12-08	Instruktur	I01	TI-105	2	3	1
8	2017-12-04	Asisten	A01	TI-103	4	1	1
9	2017-12-11	Asisten	A01	TI-103	4	2	1

Payroll Table

id_penggajian	status	nip	kodeMK	id_kelas	totalSesi	totalGaji	bulan	tahun	tanggalditerima	statusPengiriman
1	Dosen	D01	TI-102	3	4	400000	12	2017	2017-12-09	1
2	Asisten	A01	TI-103	4	2	60000	12	2017	2017-12-15	1
3	Instruktur	I01	TI-105	2	3	180000	12	2017	2017-12-08	1

After inserting the data into the staff table, no changes occurred in the attendance and payroll tables, implying no anomaly in data entry.

2. Update anomaly

An update anomaly testing was carried out on the staff table as it had a relationship with the attendance and payroll tables. The update anomaly testing is demonstrated in Table 5.

After updating the data in the staff table, the tables with relations and the same data changed according to the updated data in the staff table, indicating no anomaly when the data were updated.

Table 5. Update Testing on the Staff Table

Staff Table

nip	id_user	nama_staff	status	alamat_staff	nohp_staff	email_staff	password_staff
A01	2	Ohno Satoshi	Asisten	Tokyo	934567891	satoshiohno@yahoo.jp	7c978c1228b60cc41787020695f8cb77
A02	2	Ninomiya Kazunari	Asisten	Tokyo	86523456890	ninomiyakazunari@yahoo.jp	d5433b40b38af99be049364c502c88dd
D02	2	Slamet Riyadi	Dosen	Yogyakarta	87654323678	slametriyadi@gmail.com	92a968ca99da34abeeb3f2042f973cab
D04	2	Aprillia Kurniati	Dosen	Jalan Magelang	987654322123	aprilliakurniati@gmail.com	e4b3a0f4e7348df27ce5b124c09f01ac
I01	2	Sakurai Sho	Instruktur	Tokyo, Japan	975367112	sakuraisho@yahoo.jp	6ec28e0d3a75899f36a7b7c56bac3eec
I02	2	Matshumoto Jun	Instruktur	Japan	23456789098	matshumotojun@yahoo.jp	ce5ec93770844b25ef0223b169a2f08a

Attendance Table

id_presensi	tanggal	status	nip	kodeMK	id_kelas	sesi	kehadiran
1	2017-12-04	Dosen	D04	TI-102	3	1	1
2	2017-12-11	Dosen	D04	TI-102	3	2	1
3	2017-12-18	Dosen	D02	TI-101	1	1	1
4	2017-12-26	Dosen	D02	TI-101	1	1	1
5	2017-11-01	Instruktur	I01	TI-105	2	1	1
6	2017-11-01	Instruktur	I01	TI-105	2	2	1
7	2017-12-08	Instruktur	I01	TI-105	2	3	1
8	2017-12-04	Asisten	A01	TI-103	4	1	1

Payroll Table

id_penggajian	status	nip	kodeMK	id_kelas	totalSesi	totalGaji	bulan	tahun	tanggalditerima	statusPengiriman
1	Dosen	D04	TI-102	3	4	400000	12	2017	2017-12-09	1
2	Asisten	A01	TI-103	4	2	60000	12	2017	2017-12-15	1
3	Instruktur	I01	TI-105	2	3	180000	12	2017	2017-12-08	1

3. Deletion anomaly

A deletion anomaly testing was carried out on the staff table for having a relationship with the attendance and payroll tables. Table 6 depicts the testing for deletion anomaly.

Table 6. Deletion Testing on the Staff Table

Staff Table

nip	id_user	nama_staff	status	alamat_staff	nohp_staff	email_staff	password_staff
A01	2	Ohno Satoshi	Asisten	Tokyo	934567891	satoshiohno@yahoo.jp	7c978c1228b60cc41787020695f8cb77
A02	2	Ninomiya Kazunari	Asisten	Tokyo	86523456890	ninomiyakazunari@yahoo.jp	d5433b40b38af99be049364c502c88dd
D02	2	Slamet Riyadi	Dosen	Yogyakarta	87654323678	slametriyadi@gmail.com	92a968ca99da34abeeb3f2042f973cab
I01	2	Sakurai Sho	Instruktur	Tokyo, Japan	975367112	sakuraisho@yahoo.jp	6ec28e0d3a75899f36a7b7c56bac3eec
I02	2	Matshumoto Jun	Instruktur	Japan	23456789098	matshumotojun@yahoo.jp	ce5ec93770844b25ef0223b169a2f08a

Attendance Table

id_presensi	tanggal	status	nip	kodeMK	id_kelas	sesi	kehadiran
3	2017-12-18	Dosen	D02	TI-101	1	1	1
4	2017-12-26	Dosen	D02	TI-101	1	1	1
5	2017-11-01	Instruktur	I01	TI-105	2	1	1
6	2017-11-01	Instruktur	I01	TI-105	2	2	1
7	2017-12-08	Instruktur	I01	TI-105	2	3	1
8	2017-12-04	Asisten	A01	TI-103	4	1	1
9	2017-12-11	Asisten	A01	TI-103	4	2	1

Payroll Table

id_penggajian	status	nip	kodeMK	id_kelas	totalSesi	totalGaji	bulan	tahun	tanggalditerima	statusPengiriman
2	Asisten	A01	TI-103	4	2	60000	12	2017	2017-12-15	1
3	Instruktur	I01	TI-105	2	3	180000	12	2017	2017-12-08	1

c. Anomaly Testing of the Course Table

1. Insertion anomaly

Insertion anomaly was carried out on the course table as it had a relationship with attendance and payroll tables. The insertion anomaly testing is portrayed in Table 7.

Table 7. Insertion Testing on the Course Table

Course Table

kodeMK	namaMK
TI-101	Agama Islam 1
TI-102	Bahasa Inggris 1
TI-103	Fisika dan Elektronika
TI-104	Dasar Teknologi Informasi
TI-105	Applikasi Produktifitas Kerja

Attendance Table

id_presensi	tanggal	status	nip	kodeMK	id_kelas	sesi	kehadiran
1	2017-11-06	Dosen	D04	TI-102	1	1	1
2	2017-11-13	Dosen	D04	TI-102	1	2	1
3	2017-11-20	Dosen	D04	TI-102	1	3	1
4	2017-11-27	Dosen	D04	TI-103	1	4	1
5	2017-11-01	Instruktur	I01	TI-105	2	1	1
6	2017-11-01	Instruktur	I01	TI-105	2	2	1
9	2017-11-08	Instruktur	I01	TI-105	2	3	1

Payroll Table

id_penggajian	status	nip	kodeMK	id_kelas	totalSesi	totalGaji	bulan	tahun	tanggalditerima	statusPengiriman
1	Dosen	D04	TI-102	1	4	400000	11	2017	2017-11-30	1
2	Instruktur	I01	TI-105	2	9	540000	11	2017	2017-11-30	1
4	Dosen	D02	TI-101	1	1	100000	11	2017	2017-10-31	1

After inserting the data into the course table, no changes occurred in the attendance and payroll table, indicating no anomaly in data entry.

2. Update anomaly

Update anomaly was carried out on the course table since it was related to the attendance and payroll tables. Table 8. presents the update anomaly testing. After updating the course table, tables with relations and the same data changed following the updated data in the course table, indicating no anomaly occurred when the data were updated.

Table 8. Update Testing on the Course Table

Course Table

kodeMK	namaMK
TI-101	Agama Islam 1
TI-102P	Bahasa Inggris 1
TI-103	Fisika dan Elektronika
TI-104	Dasar Teknologi Informasi
TI-105	Applikasi Produktifitas Kerja

Attendance Table

id_presensi	tanggal	status	nip	kodeMK	id_kelas	sesi	kehadiran
1	2017-11-06	Dosen	D04	TI-102P	1	1	1
2	2017-11-13	Dosen	D04	TI-102P	1	2	1
3	2017-11-20	Dosen	D04	TI-102P	1	3	1
4	2017-11-27	Dosen	D04	TI-103	1	4	1
5	2017-11-01	Instruktur	I01	TI-105	2	1	1
6	2017-11-01	Instruktur	I01	TI-105	2	2	1
9	2017-11-08	Instruktur	I01	TI-105	2	3	1

Payroll Table

id_penggajian	status	nip	kodeMK	id_kelas	totalSesi	totalGaji	bulan	tahun	tanggalditerima	statusPengiriman
1	Dosen	D04	TI-102P	1	4	400000	11	2017	2017-11-30	1
2	Instruktur	I01	TI-105	2	9	540000	11	2017	2017-11-30	1
4	Dosen	D02	TI-101	1	1	100000	11	2017	2017-10-31	1

3. Deletion anomaly

Deletion anomaly was performed on the course table as it had a relationship with attendance and payroll tables. Table 9 displays the deletion anomaly testing.

Table 9. Deletion Testing on the Course Table

Course Table

kodeMK	namaMK
TI-101	Agama Islam 1
TI-103	Fisika dan Elektronika
TI-104	Dasar Teknologi Informasi
TI-105	Applikasi Produktifitas Kerja

Attendance Table

id_presensi	tanggal	status	nip	kodeMK	id_kelas	sesi	kehadiran
4	2017-11-27	Dosen	D04	TI-103	1	4	1
5	2017-11-01	Instruktur	I01	TI-105	2	1	1
6	2017-11-01	Instruktur	I01	TI-105	2	2	1
9	2017-11-08	Instruktur	I01	TI-105	2	3	1

Payroll Table

id_penggajian	status	nip	kodeMK	id_kelas	totalSesi	totalGaji	bulan	tahun	tanggalditerima	statusPengiriman
2	Instruktur	I01	TI-105	2	9	540000	11	2017	2017-11-30	1
4	Dosen	D02	TI-101	1	1	100000	11	2017	2017-10-31	1

After deleting the data in the course table, the data from the course table could be deleted. The deleted data in the attendance and payroll tables were only those having a relationship with the deleted data in the course table. Thus, no anomaly occurred when the data were deleted.

d. Anomaly Testing on the Staff Status Table

1. Insertion anomaly

Insertion anomaly was performed on the staff status table since it possessed a relationship with staff, attendance and payroll tables. Table 10 presents the insertion anomaly testing.

Table 10. Insertion Testing on the Staff Status Table

Staff Status Table

status	nominal
Asisten	30000
Dosen	100000
Instruktur	60000

Staff Table

nip	id_user	nama_staff	status	alamat_staff	nohp_staff	email_staff	password_staff
A01	2	Ohno Satoshi	Asisten	Tokyo	934567891	satoshiohno@yahoo.jp	7c978c1228b60cc417870206958cb77
A02	2	Ninomiya Kazunari	Asisten	Tokyo	86523456890	ninomiyakazunari@yahoo.jp	d5433b40b38af99be049364c502c88dd
D02	2	Slamet Riyadi	Dosen	Yogyakarta	87654323678	slametriyadi@gmail.com	92a968ca99da34abeeb3f2042f973cab
I01	2	Sakurai Sho	Instruktur	Tokyo, Japan	975367112	sakuraisho@yahoo.jp	6ec28e0d3a75899f36a7b7c56bac3eec
I02	2	Matshumoto Jun	Instruktur	Japan	23456789098	matshumotojun@yahoo.jp	ce5ec93770844b25ef0223b169a2f08a

Attendance Table

id_presensi	tanggal	status	nip	kodeMK	id_kelas	sesi	kehadiran
4	2017-11-27	Dosen	D04	TI-103	1	4	1
5	2017-11-01	Instruktur	I01	TI-105	2	1	1
6	2017-11-01	Instruktur	I01	TI-105	2	2	1
9	2017-11-08	Instruktur	I01	TI-105	2	3	1

Payroll Table

id_penggajian	status	nip	kodeMK	id_kelas	totalSesi	totalGaji	bulan	tahun	tanggalditerima	statusPengiriman
2	Instruktur	I01	TI-105	2	9	540000	11	2017	2017-11-30	1
4	Dosen	D02	TI-101	1	1	100000	11	2017	2017-10-31	1

After inserting the data into the staff status table, no change occurred in the staff, attendance and payroll tables, implying no anomaly in data entry.

2. Update anomaly

Update anomaly was carried out on the staff status table as it had a relationship with staff, attendance and payroll tables. Table 11. demonstrates the update anomaly testing. After updating the data in the staff status table, tables with relations and the same data changed following the updated data in the staff, attendance and payroll tables, showing that anomaly did not occur when the data were updated.

Table 11. Update Testing on the Staff Status Table

Staff Status Table

status	nominal
Asisten	30000
Doseen	100000
Instruktur	60000

Staff Table

nip	id_user	nama_staff	status	alamat_staff	nohp_staff	email_staff	password_staff
A01	2	Ohno Satoshi	Asisten	Tokyo	934567891	satoshiohno@yahoo.jp	7c978c1228b60cc417870206958cb77
A02	2	Ninomiya Kazunari	Asisten	Tokyo	86523456890	ninomiyakazunari@yahoo.jp	d5433b40b38af99be049364c502c88dd
D02	2	Slamet Riyadi	Doseen	Yogyakarta	87654323678	slametriyadi@gmail.com	92a968ca99da34abeeb3f2042f973cab
I01	2	Sakurai Sho	Instruktur	Tokyo, Japan	975367112	sakuraisho@yahoo.jp	6ec28e0d3a75899f36a7b7c56bac3eec
I02	2	Matshumoto Jun	Instruktur	Japan	23456789098	matshumotojun@yahoo.jp	ce5ec93770844b25ef0223b169a2f08a

Attendance Table

id_presensi	tanggal	status	nip	kodeMK	id_kelas	sesi	kehadiran
3	2017-12-18	Doseen	D02	TI-101	1	1	1
4	2017-12-26	Doseen	D02	TI-101	1	1	1
5	2017-11-01	Instruktur	I01	TI-105	2	1	1
6	2017-11-01	Instruktur	I01	TI-105	2	2	1
7	2017-12-08	Instruktur	I01	TI-105	2	3	1
8	2017-12-04	Asisten	A01	TI-103	4	1	1
9	2017-12-11	Asisten	A01	TI-103	4	2	1

Payroll Table

id_penggajian	status	nip	kodeMK	id_kelas	totalSesi	totalGaji	bulan	tahun	tanggalditerima	statusPengiriman
1	Doseen	D02	TI-101	1	2	200000	12	2017	2017-12-15	1
2	Asisten	A01	TI-103	4	2	60000	12	2017	2017-12-15	1
3	Instruktur	I01	TI-105	2	3	180000	12	2017	2017-12-08	1

3. Deletion anomaly

Deletion anomaly was conducted on the staff status table since it was related to the staff, attendance and payroll tables. Table 3.12 exhibits the deletion anomaly testing.

Table 12. Deletion Testing on the Staff Status Table

Staff Status Table

status	nominal
Asisten	30000
Instruktur	60000

Staff Table

nip	id_user	nama_staff	status	alamat_staff	nohp_staff	email_staff	password_staff
A01	2	Ohno Satoshi	Asisten	Tokyo	934567891	satoshiohno@yahoo.jp	satoshiiohno
A04	2	Ninomiya Kazunari	Asisten	Tokyo	86523456890	ninomiyakazunari@yahoo.jp	kazunarininomiya
I01	2	Sakurai Sho	Instruktur	Tokyo, Japan	975367112	sakuraisho@yahoo.jp	shosakuraii

Attendance Table

id_presensi	tanggal	status	nip	kodeMK	id_kelas	sesi	kehadiran
5	2017-11-01	Instruktur	I01	TI-105	2	1	1
6	2017-11-01	Instruktur	I01	TI-105	2	2	1
9	2017-11-08	Instruktur	I01	TI-105	2	3	1

Payroll Table

id_penggajian	status	nip	kodeMK	id_kelas	totalSesi	totalGaji	bulan	tahun	tanggalditerima	statusPengiriman
2	Instruktur	I01	TI-105	2	9	540000	11	2017	2017-11-30	1

After deleting the data in the staff status table, the data from the staff status table could be deleted. The deleted data in the staff, attendance and payroll tables were

those related to the deleted data in the staff status table. Thus, no anomaly occurred when the data were deleted.

e. Anomaly Testing on the Class Table

1. Insertion Anomaly

Insertion anomaly was carried out on the class table because it had a relationship with both attendance and payroll tables. The insertion anomaly testing is demonstrated in Table 3.13.

Table 13. Insertion Testing on the Class Table

Class Table

id_kelas	nama_kelas
1	A
2	B
3	C
4	D

Attendance Table

id_presensi	tanggal	status	nip	kodeMK	id_kelas	sesi	kehadiran
1	2017-12-04	Dosen	D01	TI-102	3	1	1
2	2017-12-11	Dosen	D01	TI-102	3	2	1
3	2017-12-18	Dosen	D01	TI-102	3	3	1
4	2017-12-25	Dosen	D01	TI-102	3	4	1
5	2017-11-01	Instruktur	I01	TI-105	2	1	1
6	2017-11-01	Instruktur	I01	TI-105	2	2	1

Payroll Table

id_penggajian	status	nip	kodeMK	id_kelas	totalSesi	totalGaji	bulan	tahun	tanggalditerima	statusPengiriman
2	Instruktur	I01	TI-105	2	9	540000	11	2017	2017-11-30	1

After inserting the data into the class table, no changes occurred in either attendance or payroll tables, indicating no anomaly in data entry.

2. Update anomaly

Update anomaly was conducted on the class table because it had a relationship with both attendance and payroll tables. Update anomaly testing is depicted in Table 14. After updating the data in the class table, the tables with relations and the same data changed based on the updated data in the attendance and payroll tables, depicting no anomaly when the data were updated.

Table 14. Update Testing on the Class Table

Class Table

id_kelas	nama_kelas
1	A
3	C
4	D
5	B

Attendance Table

id_presensi	tanggal	status	nip	kodeMK	id_kelas	sesi	kehadiran
1	2017-12-04	Dosen	D01	TI-102	3	1	1
2	2017-12-11	Dosen	D01	TI-102	3	2	1
3	2017-12-18	Dosen	D01	TI-102	3	3	1
4	2017-12-26	Dosen	D01	TI-102	3	4	1
5	2017-11-01	Instruktur	I01	TI-105	5	1	1
6	2017-11-01	Instruktur	I01	TI-105	5	2	1
9	2017-12-08	Instruktur	I01	TI-105	5	3	1

Payroll Table

id_penggajian	status	nip	kodeMK	id_kelas	totalSesi	totalGaji	bulan	tahun	tanggalditerima	statusPengiriman
1	Dosen	D01	TI-102	3	4	400000	12	2017	2017-12-09	1
2	Instruktur	I01	TI-105	5	9	540000	11	2017	2017-11-30	1

3. Deletion Anomaly

Deletion anomaly was performed on the class table because it was associated with the attendance and payroll tables. Table 15 displays the deletion anomaly testing.

Table 15. DeleteTesting on the Class Table

Class Table

id_kelas	nama_kelas
1	A
3	C
4	D

Attendance Table

id_presensi	tanggal	status	nip	kodeMK	id_kelas	sesi	kehadiran
1	2017-12-04	Dosen	D01	TI-102	3	1	1
2	2017-12-11	Dosen	D01	TI-102	3	2	1
3	2017-12-18	Dosen	D01	TI-102	3	3	1
4	2017-12-26	Dosen	D01	TI-102	3	4	1

Payroll Table

id_penggajian	status	nip	kodeMK	id_kelas	totalSesi	totalGaji	bulan	tahun	tanggalditerima	statusPengiriman
1	Dosen	D01	TI-102	3	4	400000	12	2017	2017-12-09	1

After deleting data on the class table, data from the class table could be deleted. The deleted data in both attendance and payroll tables were only those related to the deleted data in the staff status table. Hence, deleting data resulted in no anomaly.

4. Conclusions

The following conclusions were obtained from the results of designing and developing database of the staff payroll system in UMY. Based on the data collection method results through interviews and documentation, a database design for the staff payroll system was obtained, helping develop the UMY IE staff payroll system. The analysis and design results obtained a database consisting of eight tables: user, administrator, staff, staff status, course, class, attendance and payroll

tables. The initial table was normalized to the 3NF form. In designing the staff payroll system database, there were three users: administrator, staff and master, each with its access policy. Testing carried out on the database design of the staff payroll system were anomaly and view check. In addition, the table did not experience anomalies. These results could be used to enhance the functionality of the payroll system to be a more modern, accurate, and reliable system.

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