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Designing a QR Code Model Examination System with the Zachman Framework

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ABSTRACT

The Digital Business study program is a new study program within the Faculty of Economics and Business of Universitas Pancasakti Tegal where previously there were only 3 study programs, namely the Management, Accounting, and Taxation study programs. Every semester the Faculty of Economics and Business always holds Mid Semester Test (MST) and a Final Semester Test (FST), In both implementations, there are still queues of students who have already registered and paid for exams at the Front Office to take exam cards. This queue creates a large crowd at the Front Office and often causes the Administrative division that prints the cards and the Front Office staff to be overwhelmed in printing and distributing test cards to students. This study uses the Zachman Framework architectural model approach which is a framework in providing the basic organizational structure that supports access, integration, interpretation, development, management, and changes to the architectural devices of organizational information systems in the form of a matrix with a combination of planners and owners perspectives and the addition of two more perspectives. namely the perspective of the information system architecture which provides an overview of the design and architectural testing of the system as a novelty method.

Keywords: *Digital Business, Examination Card, Higher Education*

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INTRODUCTION

The Mid Semester Test (MST) and Final Semester Test (FST) are routines in a semester, especially in the Faculty of Economics and Business of Universitas Pancasakti Tegal. Examination certainly requires authentication for students, it is usually done by showing a test card. This exam card can only be obtained if students have registered and paid for the exam.

At every MST and FST implementation, there are still queues of students who have already registered and paid for exams at the Front Office to take exam cards. This queue creates crowds of many students at the Front Office and often causes the Administrative department to print the cards and the Front Office staff to be overwhelmed in printing and distributing test cards to students. To avoid crowds in queues for taking the exam card, it is necessary to design an information system that can help print self-test cards by students who have already registered and paid for the exam, in addition to easing the work of the Administration and Front Office, it also avoids crowds at the Front office. The exam card is designed in the form of a QR Code and can only be generated to appear during the exam according to the course. The use of QR codes is increasingly widespread in many fields such as industry, commerce, and others because it has good resistance and very high cost-effectiveness. It is also widely used for various purposes such as object tracking and product labeling (B. Tiryakioglu, 2016). It is well known that the use of QR codes in education can be placed in the category of mobile learning context which is the main field of education research (Kukulska-Hulme, A., & Traxler, 2005) (Pachler, 2010). Many creative ideas in the field of education accommodate the QR Code in its application so that it is considered to have great potential to be explored (Law & So, 2010). QR Code is widely used as a means of transferring information directly through the scanning process without relying on manual input methods such as email or SMS. Besides being used to provide object identity, QR Code is also very useful when sending long URL information or entering contacts (Soman et al., 2013).

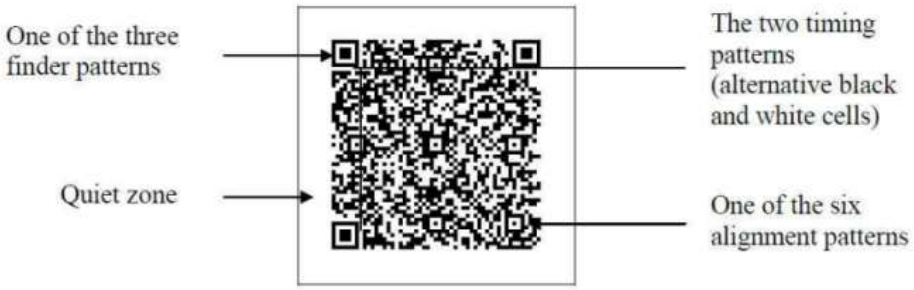
The specific aim of this study is to apply the Zachman Framework architectural model which is a framework in providing a basic organizational structure that supports access, integration, interpretation, development, management, and changes to the architectural devices of organizational information systems in the form of a matrix (O' Rourke, C., Fishman, N., & Selkow, 2003) in designing card scans exam for students. Enterprise Architecture activities are carried out through a framework, namely the process of effectiveness and efficiency arising from the elimination of non-value-added and redundant tasks, simplification of information flows, strategic placement of systems, and business restructuring (Iyamu, 2015). QR Code design which is tested in the Digital Business Study Program, the Administration Staff of the Front Office can avoid queues and crowds in taking exam cards and make it easier for them in working

so that there is no need to print exam cards for students anymore. In previous studies, there was more emphasis on the perspective of planners and owners, but in this study, two more perspectives are added, those are the information systems architectural perspective which provides an overview of system design and architectural testing as a new method.

RESEARCH METHODOLOGY

QR (Quick Response), which is a 2D bar code that can only be read by a cellphone equipped with a QR Code scanning camera. QR Code is the 2D barcode as shown in Fig. 1 below which was developed by Denso-Wave, which is an automatic data capture equipment company in Japan in 1994 (Denso, 2010).

Figure 1. QR Code Design



The IS Research Center (CISR) at MIT defines Enterprise Architecture as organizing logic for business processes and IT capabilities that reflect the integration requirements and standardization of enterprise operating models (CISR, 2023). The application of corporate Enterprise Architecture in universities has several important implications because Enterprise Architecture provides a coherent platform to manage fragmented organizational and operate processes to increase overall efficiency. In higher education institutions, Enterprise Architecture leads to the creation of data and information analysis, that can be used to make strategic decisions and also reliable infrastructure and technology in there. An Enterprise Architecture can be used to maintain learning and meet various educational needs (Samar Alamri, Manal Abdullah, 2018).

Zachman's framework defines an architectural model as a set of design artifacts that have a descriptive and relevant representation which describes an object that can be made according to requirements (quality) and maintained over its useful life (change). Zachman's framework has seen the expansion of many organizations in all of life's work (Benkamoun, N., ElMaraghy, W., Huyet & Kouiss, 2014). Columns from the Zachman Framework describe different focuses or product abstractions from various perspectives. Each focus refers to a question where the way the question is answered depends on the perspective. So that perspective requires the form and details needed to make each question clear and understandable (Minoli, 2008).

Figure 2. Zachman Framework (Zachman, 2012)

	What (Data)	How (Function)	Where (Locations)	Who (People)	When (Time)	Why (Motivation)
Scope {contextual} Planner	List of things important to the business	List of processes that the business performs	List of locations in which the business operatses	List of organizations important to the business	List of events/ cycles important to the business	List of business goals/strategies
Enterprise Model {conceptual} Business Owner	e.g. Semantic Model	e.g. Business Process Model	e.g. Business Logistics System	e.g. Workflow Model	e.g. Master Schedule	e.g. Business Plan
System Model {logical} Designer	e.g. Logical Data Model	e.g. Application Architecture	e.g. Distributed System Architecture	e.g. Human Interface Architecture	e.g. Process Structure	e.g. Business Rule Model
Technology Model {physical} Implementer	e.g. Physical Data Model	e.g. System Design	e.g. Technology Architecture	e.g. Presentation Architecture	e.g. Control Structure	e.g. Rule Design
Detailed Representation {out-of-context} Subcontractor	e.g. Data Definition	e.g. Program	e.g. Network Architecture	e.g. Security Architecture	e.g. Timing Definition	e.g. Rule Definition
Functioning System	e.g. Data	e.g. Function	e.g. Network	e.g. Organization	e.g. Schedule	e.g. Strategy

This research focuses on the application of Enterprise Architecture as a reference in designing a QR Code model test card system in the Digital Business study program. The framework used is the Zachman Framework with a 3x6 matrix, which consists of:

1. Scope/Planner's View, apply by setting the context, background, and purpose of the system will be made.
2. Business Model/Owner's View, apply by establishing a conceptual model that will be applied to universities.
3. Information System Architecture, which describes the system architecture created using the UML method, including Use Case Diagrams, Activity Diagrams, and Deployment Diagrams, and how the information system architecture was developed.
4. System testing architecture where at this stage the information system testing process is defined.

Zachman Framework modeling are be described in six columns, each of which describes the type of artifact, including:

1. What, this column focuses on data entities and provides an overview of the enterprise's information needs. It also discusses the relationship between entities, the efficiency of data storage, and the database technology used.
2. How this column relates to business processes that run in an enterprise and determines what kind of information system is suitable for achieving the vision and mission of the enterprise.
3. Where this column focuses on describing how information and processes are distributed within an enterprise.

4. Who, this column focuses on who contributes to related work and describes how the relationship between work and the structure of responsibilities and authorities in an enterprise.
5. When, this column focuses on time and cycles, and is used to design relationships between events.
6. Why, this column focuses on goals and objectives as well as strategies or methods on how to manage an enterprise system according to the initial objectives.

RESULT AND DISCUSSION

The results of the mapping process into the framework are used and described one by one in Zachman's framework to produce the required system design.

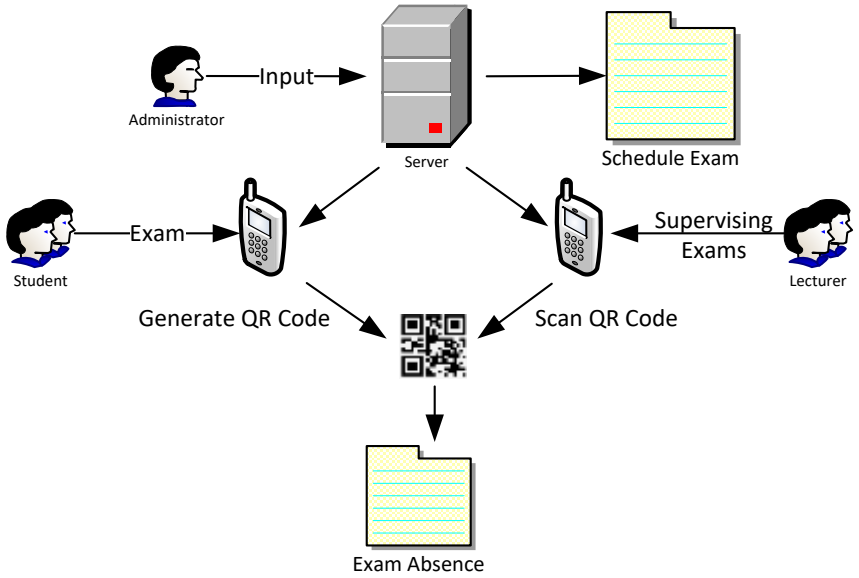
Scope/Planner's View

In this perspective, a functional business model is defined globally and describes what data is used :

Table 1. Planner's View Matrix

Artifacts	Focus
What	Examination card system by generating a QR Code from the student's side and QR Code scanning techniques from the lecturer supervisor's side. The data needed in designing this architecture are student data, exam schedule data, and course data.
How	Examination schedule data will appear according to the date and time of the exam from both the student's cell phone and the lecturer's supervisor. Students generate a QR Code icon for scanning, while the lecturer supervisor scans the QR Code from the student's cellphone. The process can be seen in Figure 4.
Where	Digital Business Department, Faculty of Economics and Business Universitas Pancasakti Tegal, Central Java.
Who	The entities that play a role in this architectural design are administrators, lecturers, and students.
When	Implementing during MST and FST
Why	Avoiding queues when picking up exam cards and facilitating Administrative work so that there is no need to print exam cards for students and simplifying the exam attendance process by scanning the QR Code of examinees.

Figure 3. Flow Design Architecture



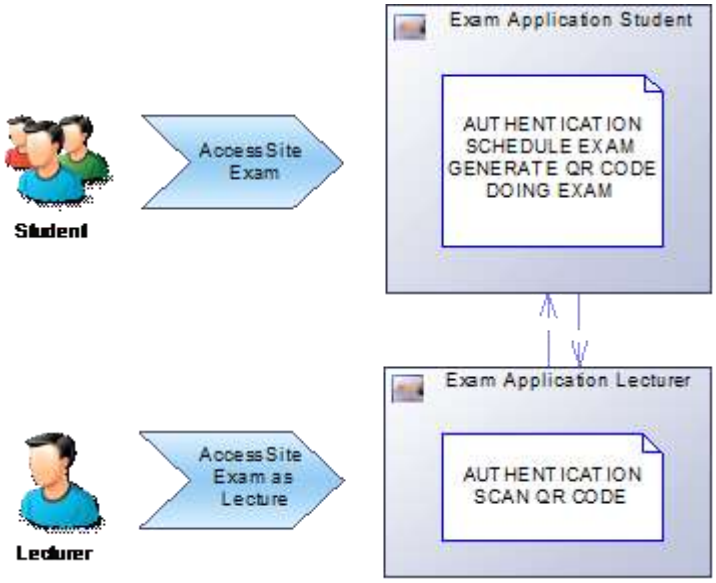
Business Model/Owner's View

From this perspective it is defined about the proposed information system and how the system will work:

Table 2. Owner's View Matrix

Artifacts	Focus
What	Simple business model concept on entities related to examination card system process using QR Code scan. The process can be seen in Figure 5.
How	During exam time, students log into the examination system and generate a QR Code through the Encoder process in the form of a QR Code. This QR Code will be scanned using a QR barcode reader application camera by the lecturer supervisor via cellphone. The QR Code decoding process is processed in the application software and saved to the database.
Where	The scan process is carried out in class during the examination.
Who	The entities that play a role in this process are lecturers and students.
When	Implementing during the examination
Why	To implement information system technology in making a test card scanning system using generate QR Code and scanning for the examination absence process so that there is no longer a queuing process for taking examination cards at the Front Office.

Figure 4. Flow System Architecture Scanning QR



Information System Architecture

Business Architecture design, which describes how business processes achieve system goals are made explained in the Use Case Diagrams, Activity Diagrams, Deployment Diagrams, and Technology Architecture as follows:

Figure 5. Use Case Diagram

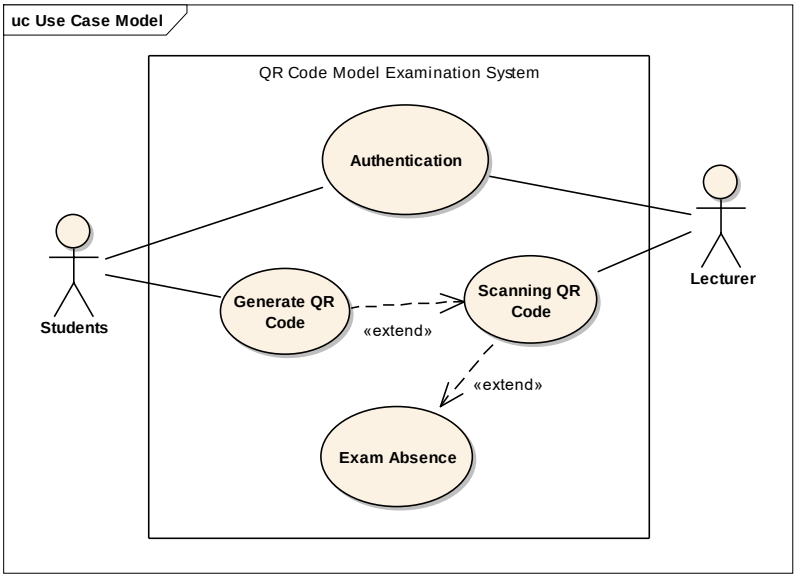


Figure 6. Activity Diagram

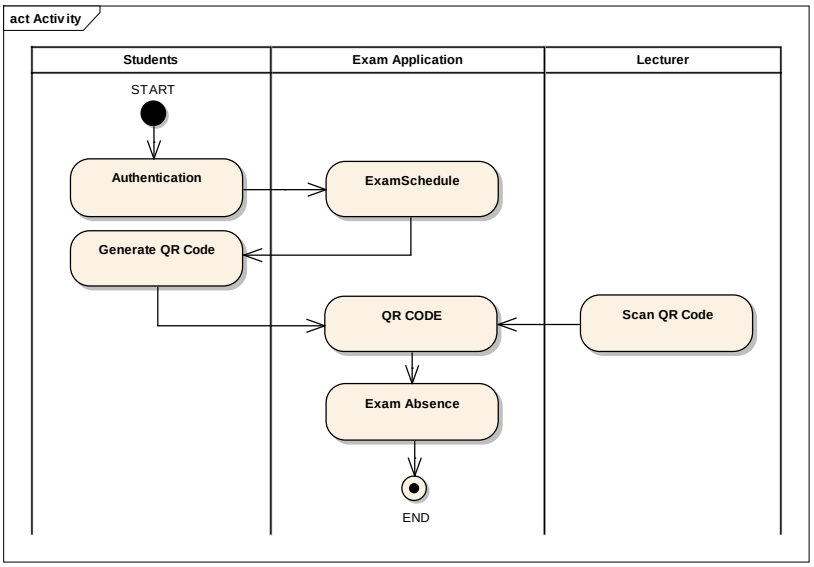


Figure 7. Deployment Diagram

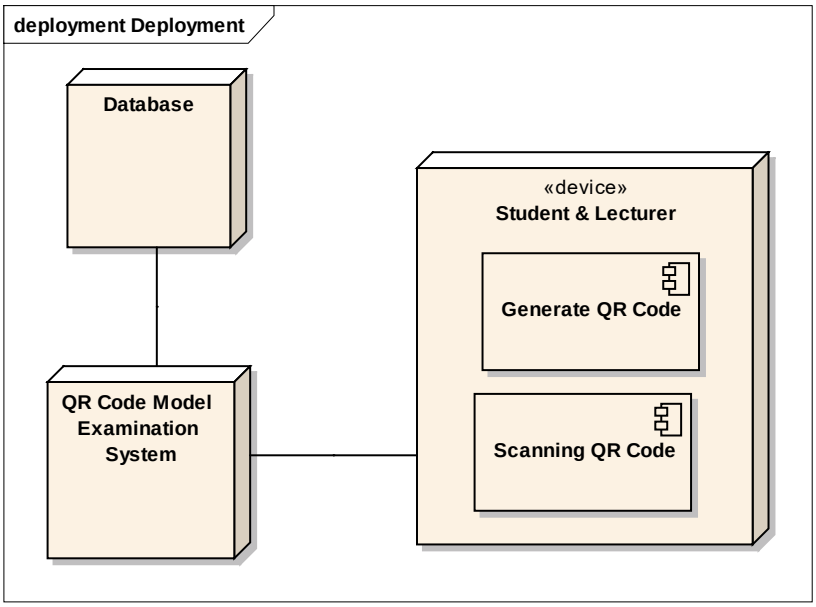
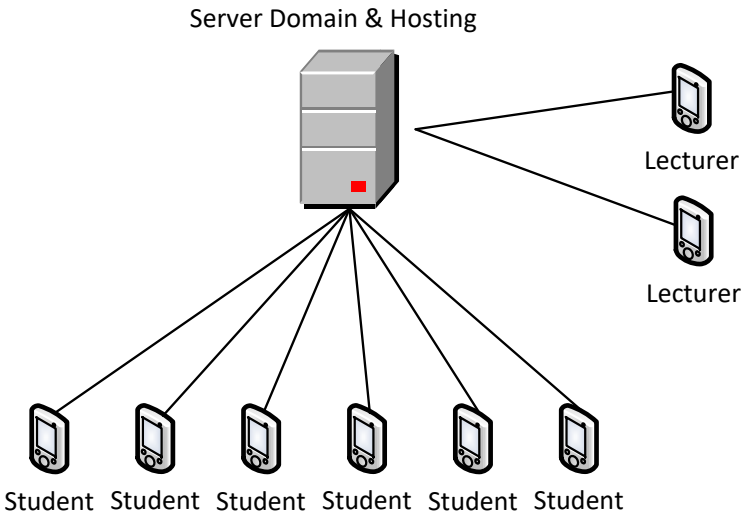


Figure 8. Architecture Technology



Testing Architecture

Integrated system testing uses the Black Box testing technique based on Equivalence Partitioning by testing the QR Code generation and QR Code scanning features. Testing the generate QR Code feature when clicking a card will produce a QR Code output that is ready to be scanned. It can be concluded that the test is valid.

Figure 9. Equivalence Testing Class 1

Testing the QR Code scanning feature produces a check mark so that the QR Code cannot be scanned twice, besides that the scanned data also appear automatically. It can be concluded that the test is valid.

Figure 10. Equivalence Testing Class 2

The following is the result of the test table using the Equivalence Class testing type:

Table 3. Result of Testing Equivalence Class

No.	Data Test	Input	Expected Test Results	Out	Result
1	Generate QR Code	Click the QR Code icon	Displays a QR Code icon image to scan	QR Code Display	The generated QR Code is valid
2	Scanning QR Code	Scanning QR Code on students' cellphones	Absence data is stored in the database then the QR Code icon changes to the OK icon	The OK icon appears	The scanned QR Code is valid
3	Check the absence data on the exam attendance list	Select the courses to follow	The student's name appears in the absence	The student's name appears according to the generated on the course being tested	Absence of data results that appear valid

CONCLUSION

The results of examination design using the QR Code as a substitute for examination cards using the perspective of the Zachman Framework can provide a complete and clear design from the perspective of the Planners and Owners. The addition of two more perspective collaborations, namely the information system architectural perspective provides a UML design model that is quite detailed for the design of this system as well as the addition of an architectural perspective for system testing can ensure that the final quality of this system is very ready to be implemented

because the two of important things, namely the QR Code generation process and Scanning the QR Code does not experience errors and has been running according to the specified business process.

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