

# Adaptation and Utilization Phase of Radio Frequency Identification (RFID) Technology at Lancang Kuning University

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**Abstract:** The development of computer technology that is in line with the human will to facilitate daily work, this gave rise to the idea of being able to develop inventions to be used both individually and in groups as part of an agency/institutional organization. In recent years, automatic identification (Auto-ID) procedures have become very popular especially in campus and industrial environments; contactless identification has developed into an independent interdisciplinary field, which is no longer suitable for the use of any (conventional) single-discipline focus. The RFID technology in this case is a discipline of several elements from very diverse disciplines: databases, RF and EMC technology, semiconductor technology, data protection and cryptography, telecommunications, manufacturing technology, and many related fields. The linkage of this research with developed technology (RFID) are several stages of analyzing the readiness of Lancang Kuning University in adopting the latest technological developments, based on a priority scale; analysis of input from the survey followed by making analysis of project development in the form of modeling and equipment requirements to build RFID technology according to priority scale. The method used follows the rules and stages of structured research in the form of experimental research methods, review of urgency background, survey techniques, analysis and prototype design produced in the form of recommendations. It is hoped that this report can be used as a reference in the development and stages that can be useful for further development and research.

**Keywords:** Adoption Technology, RFID in Campus, Priority Scale in Adoption

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## 1. Introduction

The functionality and adoption of computer technology is in line with the human will to facilitate daily activity, this progress gives rise to the idea of being able to develop inventions to facilitate daily routinely, whether in condition of individually or and in groups as part of an agency / institution organization.

In recent years, automated identification procedures (Auto-ID) have become very popular in many service industries, purchasing and distribution logistics, industrial, manufacturing enterprises and material flow systems. There are automated

identification procedures to provide information about people, animals, goods and products in transit.

The large number of companies actively involved in the development and sale of RFID systems shows that this is a market that must be taken seriously. While global sales of RFID systems were around US\$900 million in 2000, it is estimated that this figure will reach US\$2650 million in 2005 (Krebs, n.d.). Therefore, the RFID market is one of the fastest growing sectors of the radio technology industry, including cell phones and wireless telephony.

Furthermore, in recent years, contactless identification has developed into an independent interdisciplinary field, which is no longer suitable for one use of a single (conventional) focus on

one discipline. It brings together elements from very diverse fields: RF and EMC technology, semiconductor technology, data protection and cryptography, telecommunications, manufacturing technology and many related fields.

By considering the development of the needs mentioned above, it is appropriate for academic institutions to be the pioneers as to the application of the latest appropriate technology.

The purpose of this activity is to assist the Lancang Kuning University Institution in preparing the steps for selecting the appropriate type of RFID technology. Based on the phenomena described above, it can be understood that there is a need for an exclusive study to explore concrete needs and solutions as answers which are academic in nature.

## 2. Background

### 2.1. Information System: Scope Area

Coverage of information systems field. Since the 1990s, the application of information and communication technology (ICT) has fundamentally changed the way organizations do business. These changes create opportunities for researchers to

make significant contributions to knowledge while they also help organizations to better manage these changes. The Organization for Economic Cooperation and Development (OECD), recognizes the structural impact of these technology-enabled innovations:

“The Internet and related advances in information and communication technology (ICT) are transforming economic activity, just as steam, rail and electric engines have in the past. [1]

Information Systems as a field of study developed in response to the increasing need for organizations to improve their ability to process and manage data. The beginning of this reflection, an information system was initially seen as a computer application to help organizations process their data so that they can improve their information management. Indeed, information systems are used for data communication processing systems [8].

Theories related to technological innovation impact and are influenced by design decisions made with respect to the system development methodologies used and the functional capabilities, information content, and human interfaces implemented in information system [11].

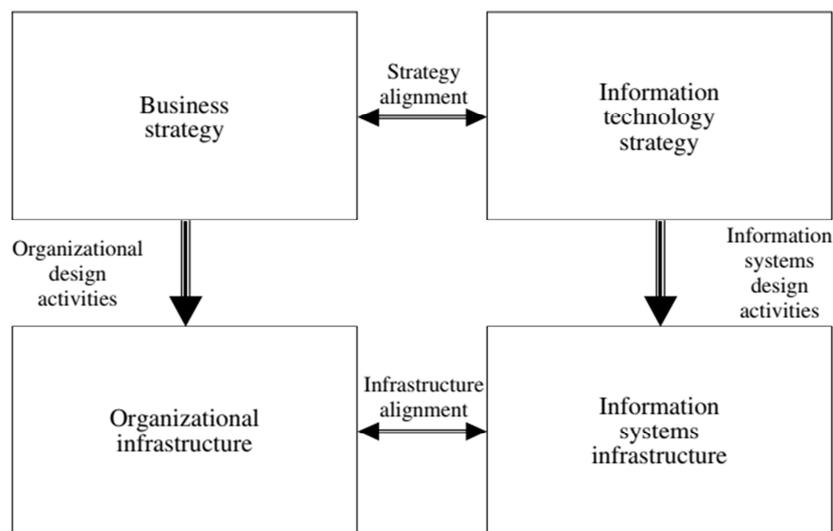


Figure 1. Organizational Design and Activity System Design (Henderson and Venkatraman, 1993).

### 2.2. What is RFID (Radio Frequency Identification) Technology

Unprecedented enthusiasm for radio frequency identification (RFID) technology at this time. RFID is based on the exchange of information signals carried by electromagnetic waves between a label, or tag, and a reader [2]. The technology is currently in economic growth, which is manifested in a variety of widely supported research activities, some of which have been implemented in terms of organizational and institutional needs. There are several annual international conferences dedicated specifically to this theme, and RFID sessions are included at every conference around microwaves, RF systems, or communications issues.

This can be explained by the versatile quality of this approach, which makes it possible to handle a very wide domain from software to components [9]. Currently, there are thousands of applications involving RFID. Here too, the spectrum is quite large, from logistics to passports but also includes custom domains, some of which are quite unexpected. This very wide variety of applications has resulted in a large number of limitations, which differ according to the field of intended use, which require the manufacture of tags of various sizes, capable (or not) to withstand high mechanical stresses or temperatures or to ensure secure data exchange. In response to this need, which sometimes proves to be incompatible, various RFID technologies have emerged from time to time. That is why radio frequency technology is pluralist [10]. Just trying to

categorize RFID technology into groups by itself is quite a tricky job. Of these technologies, we will pay particular attention to passive RFID (meaning there is no energy source on the tag side) and ultra-high frequency (UHF) (in which format the signal exchange is carried out by propagation and not by coupling). This technology has surpassed HF technology, which has a short reading distance and which makes reading much more difficult than reading contacts.

### 2.3. The Working Principle of Radio Frequency Identification (RFID) Technology

Radio frequency identification (RFID) is a key technology that, for more than a decade now, has experienced significant developments in terms of applications. The traceability market includes a large number of label groups, with each of these groups meeting very specific needs. This tag includes a label consisting of the antenna and the information medium (usually a silicon chip); some contain batteries (active tags) and some do not (passive tags), [4].



Figure 2. Schematic of operation on the RFID system.

Antenna design is at the heart of the problems currently faced by UHF RFID. This is the reality, because the antenna design for UHF RFID tags differs in many ways from the classic RF antenna design. Before going into specific details about this distinction, note the following two points: (1) the immediate environment, i.e. the object in which the tag is placed for use and which is unknown to the designer, although the tag should be able to function for the greatest number of applications, for reasons of effectiveness charge and (2) the antenna is connected to a chip which, when operating, varies its input impedance between two input values.

“The main advantage of RFID is its ability to automate ID retrieval procedures. It reduces human interaction to limit input errors, and increases the speed of information retrieval. RFID is used in thousands of applications; At present, it is mainly used in the security (access control), traceability and identification sectors, and will soon be used in low-cost wireless sensors and short-range localization systems. From this, it is clear that each application has its own limitations, which must be considered by RFID. These limits can vary widely, regarding tag dimensions, cost, reliability, security,

etc.; and may even conflict from one application to the next. Taking the reading distance example, it is clear that for security applications (access badges), short distances are preferable, whereas for large retailers a longer reading distance is required to carry out an inventory. So, all of these applications generated a large number of constraints, which resulted in the application of not only one RFID technology, but a large number of them. This is why, if we take a closer look at RFID tags (Figure 2), we can see how far apart they are from each other. As a result, we are talking about the RFID tag family, which should consist of subfamilies, and so on.” [5].

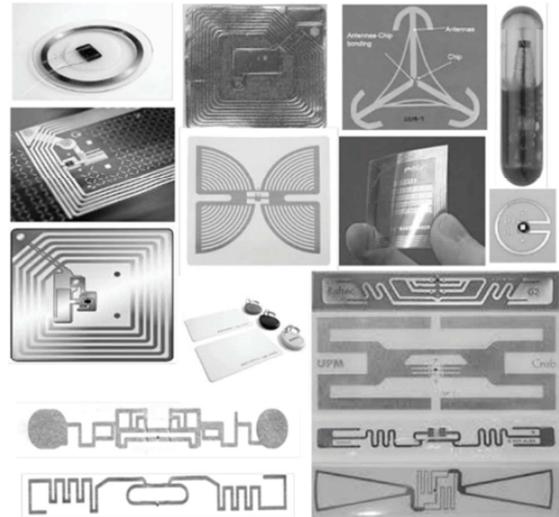


Figure 3. Different types of RFID Tags.

Schematic of RFID application components, can be explained: In accordance with the limitations of the discussion of the plan, the realization of RFID that stores various goods in different quantities in supermarket warehouses. In addition, when food supplies run out, etc. Therefore, as its predecessor, we can better understand what RFID technology is.

Basic RFID technology. There are many types of RFID technology, so it is necessary to carefully consider the selection of the type that is suitable for the application to be built. This is important, so that RFID-based systems can do it Effectively and efficiently, can reduce operating costs and increase efficiency. The division of the type of RFID technology depends on the type of frequency used and send the signal. Classification based on operating frequency is divided into three types, namely band frequency, low frequency (LF), high frequency (HF) and ultra-high frequency (UHF). Although the classification is based on the ability to send signals, it can be divided into active RFID systems and passive RFID systems. In the block diagram, the RFID system is active.

## 3. Research Method

### Research Studies

At this stage of the research methodology, describes the

methods and stages of the application of RFID technology at Lancang Kuning University.

The method used is a quantitative research method, in which several stages are prepared which are sequential work levels in a structured manner. Among the design stages can be described in the following figure:



**Figure 4.** Design Process of research on the application of RFID technology at Lancang Kuning University formulation.

The steps to be carried out in this study refer to the steps in the illustration above.

- 1) Problem identification is carried out by looking at issues that develop in the need and ease of application of technology. Besides this activity, it is also a scientific development that is owned by each teaching staff (lecturer) and students (students).
- 2) Problem formulation, after the problems can be identified, the next step can be formulated problems with reference to the benefits that will be obtained after the completion of the series of stages of this research.
- 3) Hypothesis. The initial assumption that can be drawn is the need to select several RFID technologies to be applied at Lancang Kuning University.
- 4) Quantitative Research Methods, the research method carried out is based on the philosophy of usefulness. The analysis of the data used is quantitative or can be measured with the aim of testing pre-determined hypotheses.
- 5) Data collection, data was collected using an online survey method, namely by providing several questions related to the choice of RFID technology to be applied at the Lancang Kuning University institution, by providing indicators of urgency and other factors. The survey was given to leaders within the rectorate, faculties, and students.
- 6) Data analysis, the method chosen in this study depends on the accurate calculation of the data. In addition, this method is also used to interpret complex data. Some methods of quantitative analysis, such as descriptive analysis.
- 7) Prototyping. The stages of making this prototype are intended to provide a detailed model of the RFID system so that the physical device development process

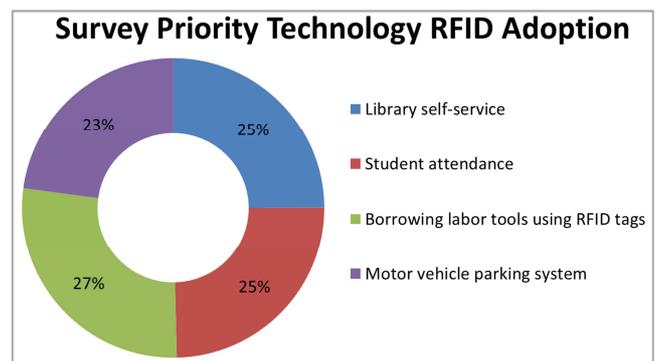
can be carried out.

## 4. Result and Discussion

### 4.1. Results

After conducting a survey to the academic community of Lancang Kuning University, by distributing a google form questionnaire. The questionnaire was distributed to all faculties within the university.

Based on the stages of data analysis using the process of making it easier to read the results of the survey to the Unilak community, the data can be displayed through the diagram below. Where it can be seen that the tendency of the academic community to see the priority scale of the possibility of RFID technology that can be implemented in the campus environment as much as 27% of respondents prefer the urgency of borrowing faculty labor tools / equipment even though the difference in the gap for priority scale as much as 25% of respondents choose to prioritize the application of RFID technology Presence / Student daily attendance and library self-service using tag cards.



**Figure 5.** Diagram of the results of a survey of UNILAK community respondents.

Based on the results of the survey analysis described above, the research team made a decision based on the survey results, namely making a prototype / design of RFID technology for borrowing labor equipment using RFID technology.

We can explain further, the use of RFID Tag technology through student identity cards as a medium for access to borrowing and returning laboratory equipment.

#### PROTOTYPE

##### i. RFID technology for borrowing labor tools

This section will discuss the overall system design which includes two parts, namely: hardware or hardware design, and software or software. Each part is arranged according to the initial planning so that the functions and objectives can be focused on the design planned in the system block diagram.

##### ii. System planning

At this stage the design of the RFID tag and reader (RC 522), NodeMCU ESP8266, database system, web system, indicators (led and buzzer), and MQTT protocol are

described in the block diagram below.

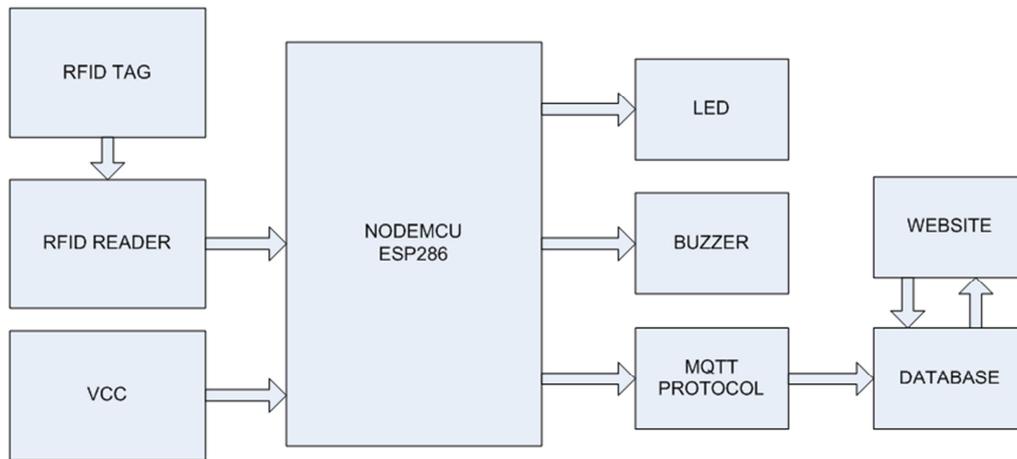


Figure 6. Block diagram of RFID System design.

iii. System working principle

This system works when the python program "bridge.py" (can be called a system that will bridge data transmission using the MQTT protocol) is run first using the command prompt. Then the RC522 reader will scan the tag on the item to be borrowed, then the tag ID will be checked in the system database for further processing into the website system.

iv. Hardware requirements

The RFID system mainly has four components:

1. Electronically programmed RFID tags/transponders with unique information
2. Reader or Sensor to ask tag.
3. Antenna.
4. The server where the software that interacts with the integrated library software is loaded.
5. RFID Label Printer
6. Handheld Reader
7. Self-Check Unit
8. External Book Return
9. Staff and Conversion Station

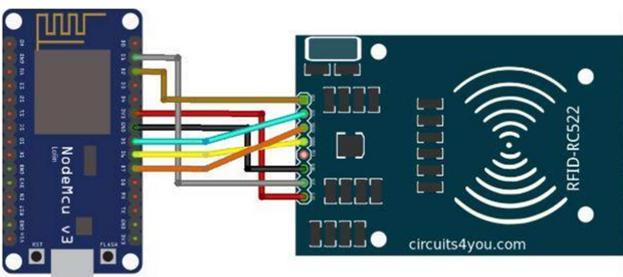


Figure 7. RFID receiver RC522.

Connecting the RFID Unit:

After the tag reader is connected to the main NodeMCU ESP286 device, the next step is to connect the main device to the LED indicator to provide a response to the user whether the tag reading status is successful (green LED is on) or not detected (red LED is on). Like the picture below.

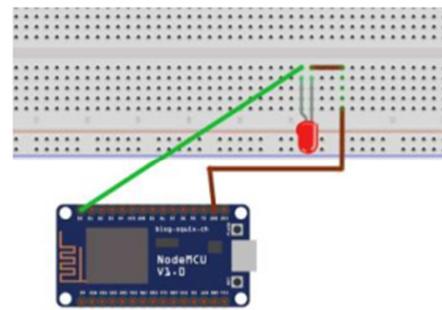


Figure 8. Wiring connection to LED indicator.

User Notification:

Confirmation of the user can also use a buzzer device as shown in the image below:

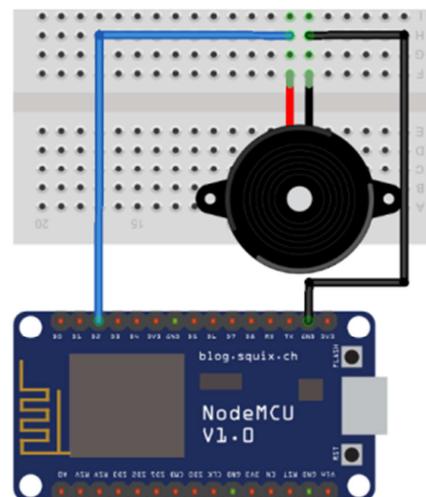


Figure 9. Wired buzzer connection with main device.

v. Software Design

The following software design is described through a system prototype flowchart.

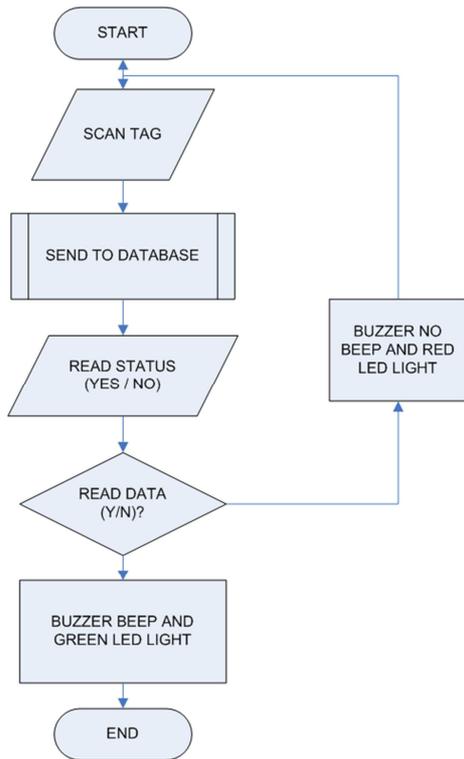


Figure 10. RFID software application work system flowchart.

vi. Database Design

Database design is needed for the whole process of the RFID system for borrowing this labor tool. Where the equipment data to be borrowed by the user is first inputted into the database table. From the following flowchart, it can

be explained the flow of data recognition that is processed by the system, so that it can run according to the design.

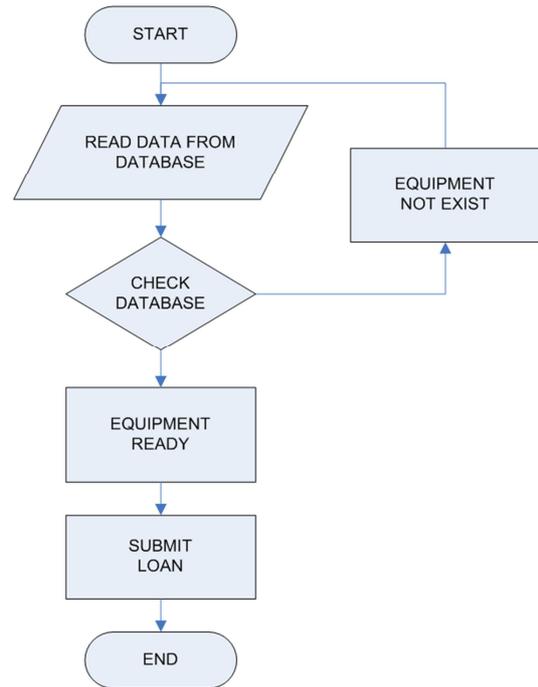


Figure 11. Flowchart of database synchronization against RFID system.

In the database design for this laboratory equipment lending system, MySQL tools will be used. This database serves as the storage and management of website system data.

Table 1. Transaction entity.

No	Attribute Name	Data Type	Length	Description
1	id	int	11	Item number
2	borrower	varchar	50	Borrower name
3	dateborrow	datetime	-	Borrowing date
4	datereturn	datetime	-	Borrowing deadlines
5	Status	int	1	The status of the item has been returned or has not been returned
6	email	text	-	Borrower email
7	datereceipt	datetime	-	Date of receipt of borrowed goods
8	recipient	varchar	50	The name of the admin who received the goods

Table 2. Tabel transaction\_item.

No	Attribute Name	Data Type	Length	Description
1	id	int	11	Item number
2	transaction_id	int	11	Transaction id number
3	item_id	int	11	ID of each item
4	status	int	11	status: Borrowed or Returned

Based on the overall analysis process that has been described, we can provide a complete analysis of the prototype which for the next stage of the entire system development process, the next stage can be done with the development stage so that implementation can be carried out.

4.2. Discussion

Based on the results of research that has been done and took several references, including:

Utilization of information technology in schools [6]. This article discusses the analysis of the stages of the technology transfer process. In another article describing several applications that can be used related to this RFID technology [7, 8, 12, 13] it is explained that the use of RFID is wider in the application of personnel authentication applications based on biodata stored in the system. Based on the results of the journal reference literacy, we can compare that the use of RFID technology for needs analysis in the campus

environment is a comprehensive step in the analysis and prototyping process stages; these journals contributed to the research carried out.

## 5. Conclusion

The conclusions that can be drawn from the results of research on the implementation of RFID technology at Lancang Kuning University are as follows.

The survey data conducted on the Unilak academic community chose the priority of RFID technology in lending labor equipment to be more dominant, although here the gap in value is very small, with a difference of 2% compared to other technology options so that it can be applied.

The system design that is prepared (prototype) for development is described through several processes. The description of the loan system, the required tools, the system flowchart, and the database design.

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