BIKE RENTAL BUILDING MONITORING SYSTEM USING TECHNOLOGY RFID (RADIO FREQUENCY INDENTIFICATION) CASE STUDY IN BIKE.BDG

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ABSTRACT

Bike.bdg has been managed by BCCF (Bandung Creative City Forum) for approximately 3 years from first launched on 10 June 2012 when it was mayor Bandung Ridwan Kamil expressed his hope "bike sharing programs should be a solution of the congestion of the city of Bandung and also as an alternative to supporting an increase in tourism aspects." Bike.bdg now have an infrastructure, 10 shelters bike rental, the registrar 20 bicycles and 150 bicycle that can be rented to the public.

Bike.bdg is a provider of public transportation in the form of rental bicycles in the city. Tenant data management in Bike.bdg not been supported by computerized systems, for example in the bicycle rental, shelter manager tenant data write into a book. It is considered not effective because the books are prone to tear or lost due to negligence shelter manager. In addition to recording the data of tenants, the manager of the shelter obliges the tenant to submit identity cards (KTP) or student ID card (KTM) as collateral.

Application of Radio Frequency Identification (RFID) as a card tenants on bike rental system in Bike.bdg considered as appropriate solutions for the various weaknesses in managing rental bicycles..

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Keywords: Bike rental, RFID, card member

1. INTRODUCTION

Bike.Bdg has been managed by the community BCCF (Bandung Creative City Forum) for approximately 3 years from first launched on 10 June 2012 when the mayor of Bandung Ridwan Kamil expressed his hope "bike sharing programs should be a solution of the congestion of the city of Bandung and also as an alternative to supporting an increase in tourism aspects. "Bike.bdg now have an infrastructure, 10 shelters bike rental, the registrar 20 bicycles and 150 bicycle that can be rented to the public.

At this time, Bike.bdg is a provider of public transportation in the form of rental bicycles in the city. Tenant data management in Bike.bdg not been supported by computerized systems, for example in the bicycle rental, shelter manager tenant data write into a book. It is considered not effective because the books are prone to tear or lost due to negligence shelter manager. In addition to recording the data of tenants, the manager of the shelter obliges the tenant to submit identity cards (KTP) or student ID card (KTM) as collateral. Other problems arise regarding the return process bicycles. Tenants are required to return to the shelter early to take ID / KTM used as collateral. In other words, the tenant can not restore sepada in addition to the initial shelter where tenants do the bicycle rental.

While the bicycle rental fee payment transactions in Bike.bdg still done to the manager of the shelter that is still using cash corresponding price rental costs, such as when the car freeday tenants will be much do rentals than in normal days, this can lead to poor management.

In addition, the bike.bdg not have facilities such as a card for tenants who want to subscribe at the bicycle rental in the city of Bandung, tenant data management system on Bike.bdg not supported by computerized systems used to manage the data of tenants of each shelter. Very often the manager takes a long time to check the data tenants. This is because the data information of each shelter tenants still using sheets of the archives where the file is used as a report of each shelter to the manager. Application of Radio Frequency Identification (RFID) in the bike rental system is considered as the right solution to various weaknesses in managing the bike rental.

RFID (Radio Frequency Identification) is a method which can be used to store or receive data remotely by using a device called RFID tags or transponders [1], the term RFID is used to describe the various technologies that use radio waves to automatically identify a person or an object. An RFID tag is a small object, such as a sticker adhesive and can be attached to an item or product. RFID tags contain antennas that enable them to receive and respond to a query that is emitted by an RFID transceiver [2].

Based on the above background, researchers are interested to establish a monitoring system of bicycle rentals using radio frequency identification technology (RFID) that can improve the quality of services and can simplify the business processes contained in the bike rental place that results will be showcased in the form of final report with the title "Development of Monitoring System Using RFID Technology Bicycle Rental (Radio Frequency Identification) Case Studies Bike.Bdg"
The objectives to be achieved in this study are:

1. Facilitate the shelter manager in managing tenant data without having to write it into a book.
2. Speeding up the process of returning the bike by the tenant to the purpose in the heading without having to return to the shelter where the rental took place.
3. The process payment transactions can be done systematically without making payment in cash to the manager of the shelter.
4. Providing facilities to tenants in the form of a card wishing to subscribe in the bicycle rental in the city of Bandung,
5. Make it easier for managers to monitor the data in the form of tenant lease transactions as well as the return of any shelter.

2. RESEARCH CONTENT

2.1 Radio Frequency Identification (RFID)

RFID (Radio Frequency Identification) is a method of identification by means of the so-called RFID tags or transponders (tags) for storing and retrieving data remotely. Labels or RFID card is an object that can be installed or included in a product, animal, or even human beings with the purpose of identification using radio waves. [4]

RFID is a technology that uses radio frequency media in the identification process. Identification is done automatically on objects or humans without the need for manual operation. It can be concluded, RFID is a data capture technology that can be used to electronically identify, track and store the information stored in the RFID tag. [6]

RFID technology is a development of the previous identification barcode technology. The advantage of RFID is very significant when compared with the barcode is as follows:

1. Data that can be stored by the RFID tags and can be done more reprogramming of the data stored therein.
2. The barcode must be scanned optically, contacts require line-of-sight with the reader so that the physical placement of the object being scanned to be precise. And even required human intervention to do the scanning of barcodes. While RFID tags can be read without contact line-of-sight and without precision placement.

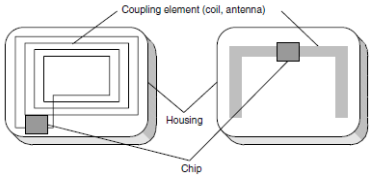
2.2.1 Main Components of RFID

RFID consists of three main components, namely:

1. RFID tag, containing a coupling element antenna which allows it to receive and respond to a query that is emitted by an RFID reader. There is also a chip capable of storing a number of unique information.
2. RFID Reader, contains a radio frequency module (transmitter and receiver), the controller and the coupling element to the tag.
3. The host computer, composed of top database that stores all the data contained in the tag. Computer systems that manage the flow of information from the detected items dala: m scope of the RFID system and manages the communication between the tag and reader.

2.1.1.1 RFID Tag

RFID tag is a small object, a component consisting of a chip and antenna. These tags can be either adhesive sticker attached to an item or product. Moreover, these tags can also be coins and cards. The shape and structure of this tag is made flexible according to the object to be identified. Figure shows the basic layout of an RFID tag:



RFID tags will work when it receives a signal from an RFID reader and will reflect the signal. There are 3 types of RFID tags by its nature, namely:

1. *Passive* RFID t*ag*

Passive RFID tags are passive tags because they do not have their own power supply. This tag works with existing electrical induction armed with the small antenna contained therein. If there is a radio frequency scanning incoming power from the reader then induction will occur so that the tags can respond by sending the data (unique information) is stored. Usually only simple information such as ID numbers only.

In the absence of power supply in the passive tag size can be made as small as possible. Currently RFID tags are already there on the market that can be placed under the skin. However, the distance range where the tag can be detected by the reader very limited (a few centimeters). Figure below is an

example of a passive tag with the following specifications:

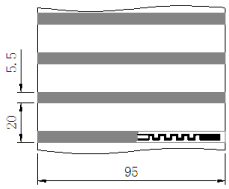
1. Working frequency: 125 kHz
2. Reading distance: 8-14 cm
3. Format: GK4001
4. Data (64-bit / etc): 64-bit



2. *Active* RFID *Tag*

Active RFID tags have their own power supply, such as batteries that can be used in part or in full to enable the circuit microchip and antenna, as well as to send a signal to the reader. Some tags can also be connected to the external power supply. These tags have a longer range distance. Memory it has also larger so that it can accommodate a wide variety of information in it. Distance range of active RFID tags that can be up to about 10 meters and with a battery life that can reach several years. Below is an example of an active tag with the following specifications:

a. Physical Characteristics



1. Size: 95 × 5.5 × 0.28mm (3.7 × 0.22 × 0.01in)
2. Material: PET; aluminum
3. Casing Material: Adhesive
4. Diameter Core Part: 76.2 mm (3in)
5. Core Width: 95 mm (3.7in)
6. The amount of the package: 5,000 inlays per roll; up to 12 rolls per carton
7. The roll diameter: 180 ± 5mm (7.1 ± 0.2in)
8. Weight: 2.32kg ± 0.05kg / roll; 10.0kg ± 0.2kg / carton (5.1 ± 0.11lbs / roll; 22.0 ± 0.44lbs / carton)

b. Performance Specifications

1. Working Frequency: 860-960Mhz
2. Standards supported: EPCglobal Class 1 Gen 2; ISO 18000-6C
3. Distance Read: ± 6 meters / 19.7 feet (depending on the reader)
4. The distance a: ± 4 meters / 13.1 feet (depending on the reader)
5. Chip Type: uCode G2XM
6. Memory: 240-bit EPC; 64-bit TID; 512-bit user memory
7. Function: Read / Write
8. Data Retention: 50 years
9. Write Endurance: 100,000 cycles
10. Anti-collision: Operation multiple tags



3. *Semipassive* RFID *Tag*

Tag semipasif menyerupai t*ag* aktif dimana *tag* Semi-passive tags which resemble the active tag, tag of this type also has its own power supply, but the batteries were owned only used to activate the microchip and antenna, are not used to transmit signals to the reader. To process a broadcast signal, the same method by means of a passive tag reader to reflect signals.

When you activate the tag, the power supply used is its own power supply, so it is not affected by the amount of power that is in induksikan by the reader. However, when sending forth, the power used comes entirely from the reader, so that a failure will occur if the distance is too far. Here is a comparison table which is a specification of some types of tags.

	Passive Tag	*Semipassive* RFID *Tag*	*Active Tag*
Power supply	Eksternal battery	Internal battery	Internal battery
Read Range	can reach 6 meters	can reach 30 meters	can reach 228 meters
Memory Type	Read Only	Read-write	Read-write
Price	$ 0.2 to $ 2 a few dollars	$2 up to $10	$20 or more
Age of Tag	20 years	2 up to 7 years	5 up to 10 years

Based on the type of memory that is owned by the tag, then there are 3 variations of the tag:

1. read-only tag, this tag has a memory capacity of small (usually less than 64 bits) and the data in it is permanent programmed so that the data can not be changed. This tag can only be used once, can not re-use. The information contained in the tag like this especially is the identification information items. Passive tags typically have a memory like this type.

2. tag read / write, the data can be updated if necessary. However, as a consequence of memory capacity will be larger and more expensive than read-only tag. Such tags are typically used when the data stored in it need to be updated in line with the life cycle of a product, for example in a factory.
3. Tag write-once read many, information is stored once and can not be changed subsequent to the data but can be read over and over again. This type of tag has a read-only security features by adding extra functionality on the tag read / write.

2.1.1.2 RFID Reader

1. The working principle is similar to the RFID reader radio transceiver, which transmits and receives. Reader is in standby mode will emit electromagnetic waves according to power its range. When there is a tag enters the area of its range, the tag will have the power of an electromagnetic wave reader.
2. From the obtained power, the tag transmits data were taken. The emission data will be received by the reader. Further data received will be forwarded to the application to be processed in accordance with the system design.
3. In its function, the RFID reader is required to be able to perform two tasks, which communicate via radio waves and carried the tag read data is then passed to the application.



Pictured above is the type of RFID reader RapidACCESS RFD220P, RapidACCESS RFD220P is fixed reader / integrated desktop that can read and write the electronic labels or tags which complies with ISO-18000-6B standard, EPC Class 1 G2 standard and EM-4222 standard. Maximum read range up to 4 meters (tag dependent). The specifications are as follows:

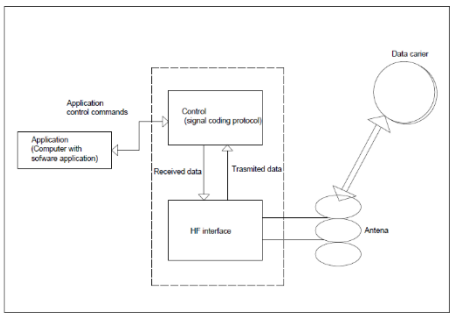
1. Read-Write tags: electronic tag with ISO-18000-6B, EPC Class1 G2 standard and EM-4222.
2. Supports data communication via RS232 port, Wiegand port, RS485 port
3. working modes: Frequency Hopping Spread Spectrum (FHSS)
4. Max. RF output power: 20 ~ 30dBm
5. Speed read: evenly, 6ms / 32bits.
6. Writing speed: evenly, 50ms / 32bits.
7. Security Mechanism: Verify the validity of the Tag.
8. Built-in anti-collision: Read up to 100 tags at a time.
9. three (3) Operation Mode Available:
   a. Continuous: Tag automatically read periodically
   b. TRIGGER: Control read tags by inserting trigger signal
   c. COMMAND: Starting to read / write by software command / API
10. Power supply: 110V ~ 220V external VAC auto start.
11. Dimensions: 250mm x 250mm x 77mm
12. Weight: 0.9kg (without wires and brackets)
13. Operating temperature: -20 C to 55 C
14. reading distance of up to 4 meters Tag, Tag writing up to 1.5 meters (tag dependent)



Pictured above is one type of RFID reader ID-12 type Innovations. RFID is a means of developing RFID reader based on the type of ID-12 which has been equipped with RS-232sehingga communication lines can be connected to the COM port of the computer directly. This module is suitable for developing applications based on RFID, for example: attendance machine RFID, RFID access controller, etc.. The specifications are as follows:

1. Power supply: 5VDC
2. Working frequency: 125 kHz
3. Reading distance: ± 12 cm
4. Interface: UART TTL / RS-232), Wiegand26, and Magnetic ABA Track 2
5. Card Format: EM4001
6. Features: Module ID-12 module can be replaced with another ID-Series.
7. Dimensions: 8.1 cm (p) x 6.2 cm (L) x 1.8 cm (t)

Reader distinguished by its storage capacity, processing capability, and frequency can be read. Compatibility reader to the tag is also noteworthy because not all of the tags with the reader will match, there is no spouse, respectively.



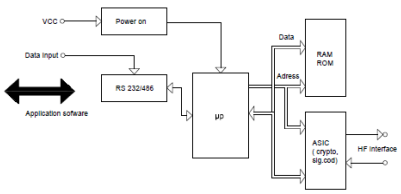
a. HF Interface

High Frequency Interface used by the reader to generate transmission signals to activate the tag and the power supply (on the passive tags), modulates the signal transmission to transmit data to the tag, as well as receiving and demodulating the signal transmission from a tag. HF Interface consists of two separate signal paths, based on the two-way flow of data to and from the tag, the data is sent to the tag through the transmission and the data received from the tag will be processed at the receiver side.

b. *Control Sistem*

Figure shows the control system of a reader. Control system has the following functions:

1. Communicate with software applications and perform commands from the application software.
2. Control method of communication with tags
3. Conducting the process of coding and decoding of the signal information



Control unit has a system in accordance with the microprocessor used. Exchange of data between application software and reader performed using serial communication via RS232 interface.

1.4 Analysis of Issues

Tenant data management in Bike.bdg not been supported by computerized systems, for example in the bicycle rental, shelter manager tenant data write into a book. It is considered not effective because the books are prone to tear or lost due to negligence shelter manager. In addition to recording the data of tenants, the manager of the shelter obliges the tenant to submit identity cards (KTP) or student ID card (KTM) as collateral.

Other problems arise regarding the return process bicycles. Tenants are required to return to the shelter early to take ID / KTM used as collateral. In other words, the tenant can not restore sepada in addition to the initial shelter where tenants do the bike rental.

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In addition, the bike.bdg not have facilities for the tenants in the form of a card. This can lead to a lack of comfort to the tenants when the rental transaction and return the bike.

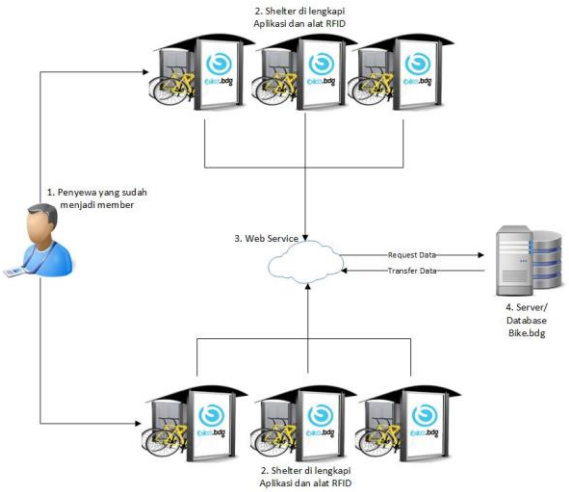
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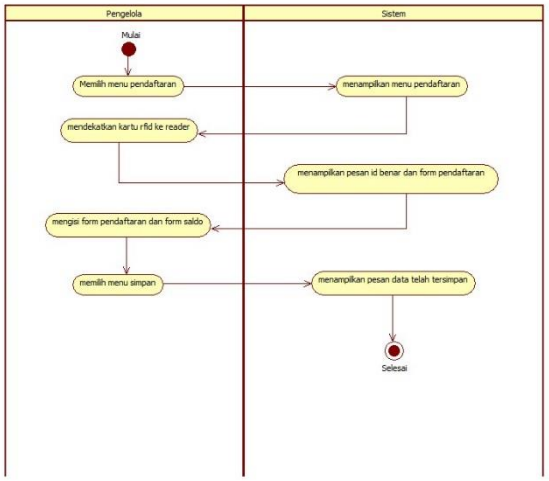
2.5 Analysis of System Architecture

System Architecture Analysis is a process to describe the physical system to be built, the components of the system to be built covering.

1. The tenant who will perform a bicycle rental must be registered as a member in the form of RFID card, the cost to become a member of Rp. Cut costs Rp 75,000 members. 25,000, the balance of which is charged Rp 50,000. and do not forget to bring a photo of 2x3 size and carry ID cards or KTM to fill out the form provided in the application menu identity and Applications Engineering Registration and Management Members, serves to manage identity data members Engine and Application Registration and Member Management, serves to manage identity data member.
2. Shelter in submitting applications and tools in the mean RFID is the RFID reader.
3. Web Service function to facilitate data exchange or bridge tenant of RFID-based desktop application that is in the shelter into the server / database with internet access
4. Server / Database Bike.bdg function for monitoring of every shelter in the form of tenant data reports.

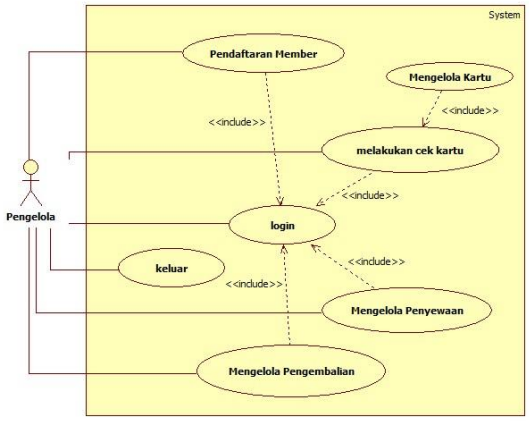
Architecture of the system to be built is shown in the following.





2.7 Use Case Diagram

Use case diagrams are diagrams that show the functionality of a system or a class and how the system interacts with the outside world and explain the functional system that the user looks. From the identification of the actors involved in the Use Case diagram above can be seen in the following figure.

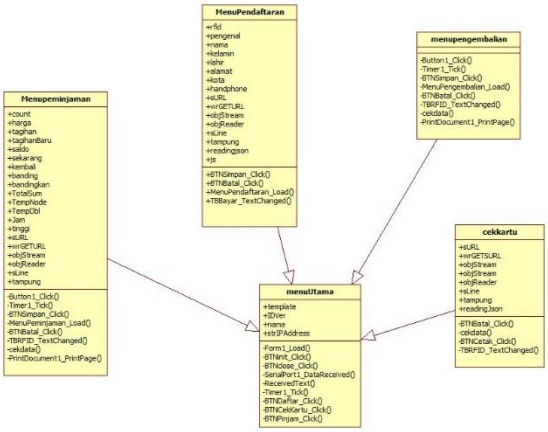


2.8 Activity Diagram

Activity diagrams model the workflow or workflow of the order of activities in a process that refers to the existing use case diagram. Activity Diagram registration processing can be seen in the figure below.

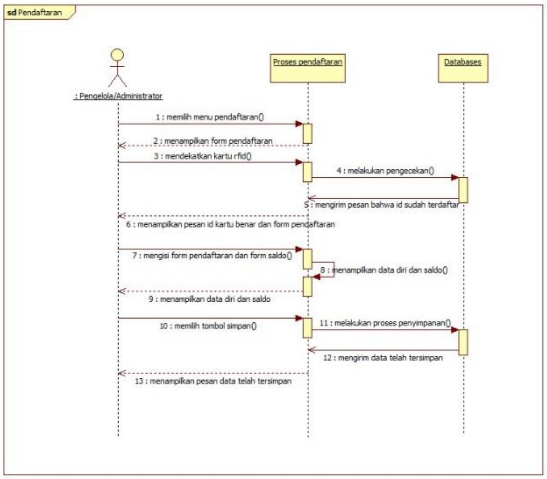
2.9 Class Diagram

Class diagrams (class diagrams) is a structural diagram that models a set of classes, interfaces, collaborations and relationships. The class diagram depicted with boxes that are basically divided into three parts: class name, attributes, and operations.



2.10 Sequence Diagram

Sequence diagrams are used to describe the behavior in a scenario. This diagram shows a number of examples of objects and messages are placed between these objects within the use case. Therefore, to describe the sequence diagram should deketahui objects involved in a use case along with methods which are owned by the class diinstansiasi into that object. Sequence Diagram registration can be seen on the following figure.



2.11 Testing System

System testing is the cornerstone that aims to discover errors and deficiencies in the software being tested. Testing intends to find software that meets the criteria is made in accordance with the purpose of the software design. This software testing using black box testing. Black box testing focuses on the functional requirements of the software.

2.11.1 Alpha Testing

Based on the results of black box testing that has been done can be concluded that the process still allows functional errors but the system is able to produce the expected output.

2.11.2 Beta Testing

Based on the results of beta testing through interviews with both the users of these systems, it is concluded that the library information system has been integrated with RFID is already sessuai with the expected goals that accelerate the process of borrowing and repayment in data management member of the tenant.

3 CLOSING

3.1 Conclusion

Based on comparison between software development purposes with the implementation and testing results, it could be concluded as the following:

1. Development of RFID systems in Bike.bdg can simplify the management of shelters in managing rental bicycles without having to write it in a book.Integration of RFID Technology in Library Information Systems circulation management services to accelerate the process of borrowing and the return of the collection of books in the library
2. The RFID system development can accelerate the process of Bike.bdg performed by the tenant without having to return to the shelter early.Library Information System are integrated with RFID Technology
3. Development of RFID systems in Bike.bdg can accelerate the process of Payments transaction without having to make a payment in cash to the manager of the shelter
4. RFID systems to facilitate the development Bike.bdg with a card already helped more efficient process management.
5. Construction of a bicycle rental system monitoring using RFID technology in Bike.bdg already facilitate the monitoring of managers in every shelter in the rental data reports.

3.8 Suggestion

Apart from the advantages of a software pastilan has shortcomings, and therefore for further development, advice that can be given isImprove data quality information :

1. Improve data quality data information renters
2. Using a smartphone to do that is using the application rental NFC (Near Field Communication)
3. Make it looks more attractive because the display used today is still quite modest.

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