

CONSTRUCTION OF PROTOTYPE DETECTION SYSTEMS FOR ILLEGAL PARKING OF INTERNET OF THINGS AT THE BANDUNG CITY DEPARTMENT OF TRANSPORTATION

Ammar Rifqi Ramadhan¹, Hanhan Maulana, S.Kom., M.Kom.²

^{1,2}Teknik Informatika – Indonesian Computer University
Jl. Dipatiukur1 112-114, Coblong Bandung, West Java
E-mail: ammarr970@gmail.com¹, hanhan@email.unikom.ac.id²

ABSTRACT

Bandung city department of transportation is a government implementing element in the transportation sector in Bandung city. Wild parking is a problem that is within the scope of the transportation agency. At present the large number of illegal parking that occurs is one of the main tasks of the Bandung city department of transportation to handle and mitigate it. The purpose of the construction of this wild parking detection system is to help the transportation office of the city of Bandung in particular in the field of control and orderliness of transportation (PDKT) to monitor the condition of the road shoulder which is usually used as illegal parking lots. To create this system, there are 6 stages of research methods ranging from problem analysis, data collection, problem formulation and objectives, software development, testing, and drawing conclusions. This system uses the CNN Algorithm to detect vehicle objects that are parked on the shoulder of the road. Based on the results of black box testing and beta testing, which includes direct interviews at the research site, the wild parking detection system can help the officers of the Bandung city transportation department control and order transportation to directly monitor illegal parking that occurs on the shoulder of Bandung city road.

Keywords: Wild Parking, CNN Algorithm, Object Detection, Bandung city department of transportation, Raspberry Pi, Shoulder Road

1. INTRODUCTION

Bandung city department of transportation is a regional government implementing element in the transportation sector that has the main task of carrying out the local government household affairs and co-administration tasks in the field of Transportation. Bandung city department of transportation especially in the field of control and transportation order, has a main task, namely to regulate the flow of vehicles, especially to control parking.

When the number of growth in the number of two wheels and four wheels is getting higher, this is also not accompanied by available parking lots. Many

motorists prefer parking their vehicles on the shoulder of the road or sidewalk in the city of Bandung. Even though the rules for obeying traffic signs already exist in article 287 paragraph 1 of law number 22 of 2009 which reads "Every person driving a Motorized Vehicle on the Road who violates the rules of order or goods declared with Traffic Signs as referred to in Article 106 paragraph (4) letter a or Road Markings as referred to in Article 106 paragraph (4) letter b shall be punished with imprisonment for a maximum of 2 (two) months or a maximum fine of Rp.500,000.00 (five hundred thousand rupiahs) ".

Based on the results of interviews conducted with Mr. Isman Suparman SE in the field of Transportation Control and Order (PDKT), the Bandung city department of transportation said that illegal parking which currently occurs in many cities in Bandung due to the lack of awareness of vehicle users to order traffic is what causes users the vehicle chooses the shoulder of the road as the parking space of the vehicle. According to him, there are currently more than 50 parking violations every day in the city of Bandung. Currently to do a vehicle search that violates the parking lot, the officers are still searching the areas that are often used for illegal parking such as in Pasteur, Diponogoro, Dipatiukur. Officers also have difficulty monitoring the condition of the road shoulder which is being used as a parking lot.

According to M. Dwiyanto, Tobi Sogen and Tubagus Maulana Kusuma that the detection of vehicles by using an opencv library has a good success rate [1].

Internet of Things in general can be interpreted as a concept to help and also facilitate the task of Bandung City Transportation Agency officers to monitor and also see the condition of the road shoulder in Bandung, so that field staff can immediately know the condition of the road shoulder that is being used by the driver as a parking lot.

Based on the problems described above, we need a system that can help the Bandung city department of transportation, especially in the Transportation Control and Order (PDKT) section to detect or monitor vehicle users who are using the shoulder of the road as a parking lot. This system is expected to

be able to help the transportation office of the city of Bandung to overcome the many illegal parking in the city of Bandung.

2. THEORY BASIS

2.1 Parking

Parking is a condition where the vehicle is not moving and is temporary. Parking also has another meaning, namely to temporarily stop a vehicle or store a vehicle in a certain space for a long time [2]. Based on the interview with Mr. Isman Suparman SE parking is a condition where the vehicle's engine is not alive or in a state of silence.

2.2 Internet of Things

Internet of Things is an activity that the culprit can interact with and can be done in the presence of an internet network. Internet Of Things is also found in many daily activities and can also help certain fields by using tools such as GPS Tracking [3].

2.3 Image

Imagery or image is a multimedia component that has a role in an information in visual form [4]. Images can also be referred to as images in the dwimatra (two-dimensional) field. Viewed from another or mathematical point of view, the image also functions to forward light intensity in the two-dimensional plane [5]. images can also be represented in two ways, namely digital images and analog images.

2.4 Raspbian

Raspbian is a free operating system based on debian and optimized for Raspberry pi hardware. Raspbian also comes with pre-installed software that can be used on web browsers, LibreOffice, etc. [6].

2.5 Object Detection

Object detection is a computer technology related to computer vision and image processing that can detect certain objects such as humans, buildings, or vehicles in the form of digital images and videos. Object detection has applications in many areas of computer vision ranging from shooting to video surveillance.

2.6 OpenCV

OpenCV (Open Source Computer Vision Library) is a computer vision library and learning software. OpenCV was built to provide a common infrastructure used for computer vision applications. OpenCV is a BSD licensed product. OpenCV supports programming languages such as C ++, Python, Java, and MATLAB. The operating system that is supported to run Windows includes Linux, Android, and Mac OS [7].

2.7 CNN

Convolutional Neural Network (CNN) algorithm is an algorithm method used to detect objects. Convolutional Neural Network (CNN) is an object

detection method that has a better accuracy than other methods [8].

2.8 Python

Python is a high-level programming language, object oriented, with dynamic semantics. The python programming language can be easily learned because it has a simple syntax. Python programming language is also very interesting for application development, as well as to be used as a scripting or glue language to connect existing components simultaneously [9].

2.9 Raspberry Pi

Raspberry Pi is a mini computer that has the size of only a credit card and can be connected to a computer monitor or TV, and can also use a keyboard and mouse like a computer in general. Raspberry Pi can be used by many people who want to learn programming languages, especially Scratch and Python. Raspberry Pi also has functions like Desktop computers in general ranging from browsing the internet, playing videos, creating spreadsheets, and also playing games [10].

2.10 Webcam

Webcam is a hardware device that can be connected to a computer so that it can be used to make video calls. Webcam can also be used as a tool to take pictures directly. The average webcam consists of a standard lens mounted on a circuit board to capture images.

2.11 UML

Unified Modeling Language (UML) is a modeling language for a system or software that is paradigmatic or object oriented. UML is also a model used to simplify problems so that they are easier to understand [11].

2.12 Use Case Diagram

Use Case Diagram is a diagram that describes a collection of use cases, actors, and their relationships. The use case is a relationship between system functionality and the internal / external actors of the system.

2.13 Activity Diagram

Activity A diagram is a diagram that describes the flow of control on a system. This diagram is used to see how the system works when it wants to be executed. this diagram shows the steps in the system work process that will be made.

2.14 Class Diagram

Class diagrams are one of the main diagrams of UML to describe the class or blueprint on a system that will be created. Class diagram formation analysis is a core activity that greatly influences the software architecture that is designed up to the coding stage.

2.15 Sequence Diagram

Sequence diagrams describe the interaction between objects in and around the system (including users, display / form) in the form of a message that is described against time. Sequence diagrams consist of vertical dimensions (time) and horizontal dimensions (related objects). Ordinary sequence diagrams are used to describe scenarios or a series of steps taken in response to an event.

3. RESEARCH METHODS

Research methodology is a process used to solve a problem and requires data to support a study. The research methodology used in this research is descriptive analysis methodology. Descriptive analysis method is a method that describes facts and information in a situation or current event systematically, factually and accurately. The flow of research methods can be seen in Figure 1.

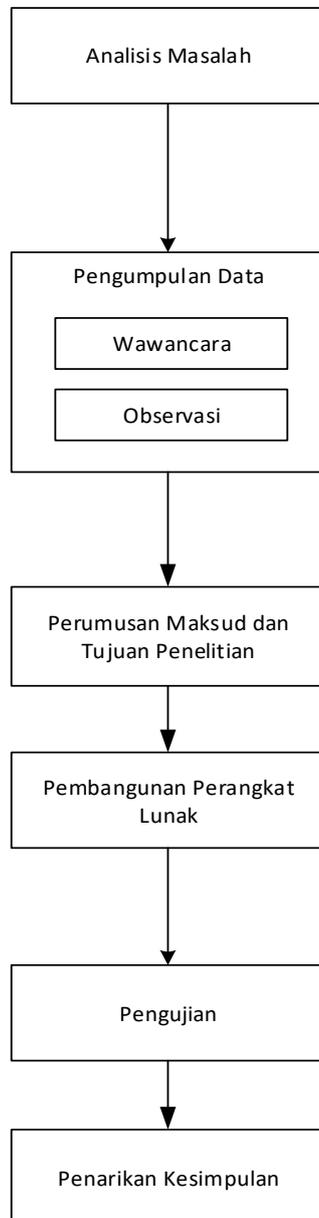


Figure 1. Research Flow

3.1 Problem Analysis

Problem analysis is a stage to identify existing problems and aims to find and also get solutions to existing problems. The problem that is being analyzed is about the illegal parking of vehicles in the city of Bandung. The solution to the problem is to create a vehicle wild parking detection system for related parties, namely the Bandung City Department of Transportation.

3.2 Data Collection

Phase to obtain information sources and also problems that exist in the field by conducting interviews with directly related parties who are able to provide detailed information. Related parties here are with Mr. Isman Suparman SE from the Bandung City Department of Transportation.

3.3 Formulation of the Purpose and Objectives of Research

Stages to formulate the purpose of the research to be carried out and formulate the objectives of the research to be conducted.

3.4 Software Development

The design phase used to build this system is by using the waterfall method. Waterfall method is a software development process that is linear in nature, in the early stages of system development from the planning stage to the final stage of system development, namely maintenance where the next stage will not be carried out before the previous stages are completed [12]. In its development, the waterfall method has several stages: requirement, design, implementation, verification and maintenance. The following is a development of waterfall software can be seen in figure 2.

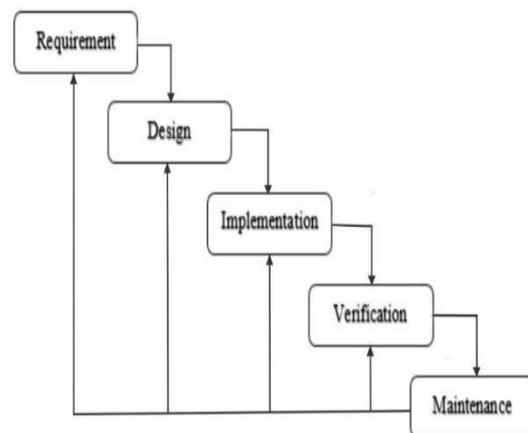


Figure 2. Waterfall

1. Requirement, is the stage of analysis of things needed in the implementation of making the system to be built.

2. Design, the stage to produce an overall system architecture for the system that will be created.

3. Implementation, the stage where the overall design is changed into program codes. The program code that is created is still a module which will be integrated as a whole to become a complete system.

4. Verification, the system testing process that has been built.

5. Maintenance, the stage where the system that has been built can experience changes or additional features.

3.5 Testing

Testing intends to test the system that has been made. The final test is done by means of black box testing and interviews directly to the research site.

3.6 Withdrawal of Conclusions

At this stage it is intended to determine the final results of the research that has been done, namely by using generalization techniques where the main focus is to draw a general conclusion.

4. RESULTS AND DISCUSSION

4.1 Analysis of Problems

Currently dishub officials are difficult to know the shoulder of the road that is used as a parking lot by vehicle users. The number of points or zones that are often used for illegal parking makes the department cannot check everywhere. The officers find it difficult to monitor the location of the road shoulder used by road users to park their vehicles.

4.2 System Architecture

System architecture analysis aims to identify the system architecture to be built. The following is the architecture that will be built in this research can be seen in Figure 3.

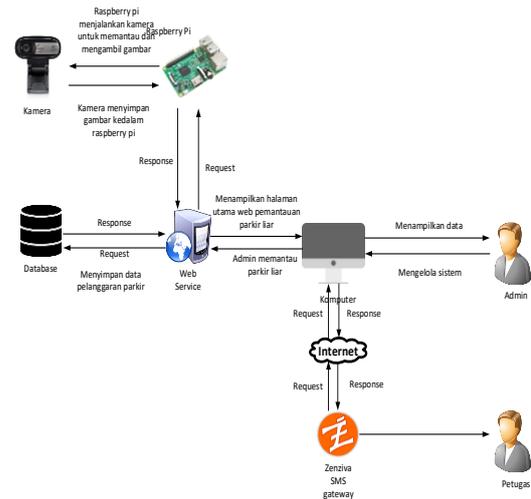


Figure 3. System Architecture

4.3 Data Communication Analysis

At the stage of data communication the data transmission of image data from raspberry pi to the destination website. To send data in the form of images that have been captured by a webcam to the intended website, a new API is created to send image data on raspberry pi to the website.

4.4 Analysis of Methods

Analysis method used for vehicle detection in the system to be built is to use Single Shot Detectors (SSD) and Convolutional Neural Network (CNN) algorithms. Single Shot Detectors function to make a bounding box on objects that will be detected, namely cars and motorcycles that are on the shoulder of the road. While the use of the CNN method aims to detect vehicles on the road.

4.5 Analysis of Non-Functional Needs

Analysis of non-functional requirements describes the needs outside the system needed to run a website-based data processing system to be built. The non-functional requirements are to run a system of illegal parking data processing violations at the Bandung City Department of Transportation covering hardware requirements, software requirements, and users who will use the system. The analysis of non-functional needs is intended so that the information system built can be used according to needs.

4.6 Analysis of Functional Requirements

Analysis of functional requirements used for the construction of a vehicle's wild parking detection system uses UML (Unified Modeling Language).

4.7 Use Case Diagram

Use case is a diagram that describes the system to be built and used to meet one or more user needs. The following is a use case diagram on the system to be built can be seen in Figure 4.

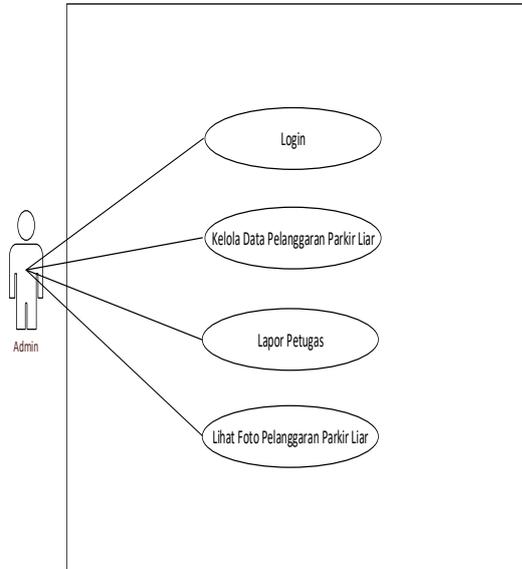


Figure 4. Use Case Diagram

4.8 Definition of Actors The

Following is the definition of actors that are on the system to be built, can be seen in table 1.

Table 1. Definition of Actors

No	Actor	Description
A-01	Admin	Admin on vehicle wild parking detection system

4.9 Use Case Definition

Following are the use case definitions that exist on the system, can be seen in table 2.

Table 2. Use Case

No	Usecase Definitions	Description
UC-01	Login	entered username and password, after that the system will display the admin page
UC-02	Manage Violation Data Wild Parking	Officers add data or delete data on illegal parking violations

UC-03	Report Officer	Officers inform field officers using SMS Gateway
UC-04	See Photos Violation Wild Parking	Officers see illegal parking violation image

4.10 System Design

System design has the purpose to see the technical aspects that will be tampered with solution in a plan. At this stage, it will be explained in detail to solve problems related to the activities being carried out starting from interface design, menu structure design, and semantic network.

4.10.1 Interface Design

Following is the main page interface of the system, can be seen in figure 5.

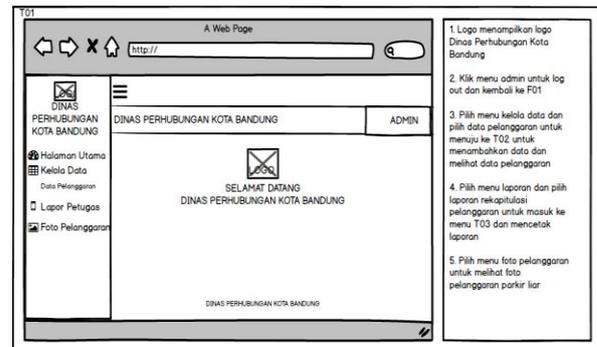


Figure 5. Main page The

Following is a page reporting officers on the system can be seen in Figure 6.

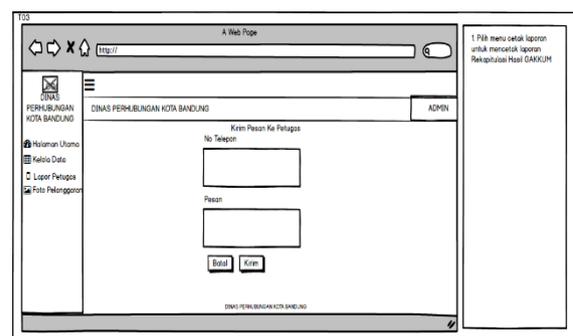


Figure 6. Page Report Officer The

Following is a page see photos violations can be seen in Figure 7.

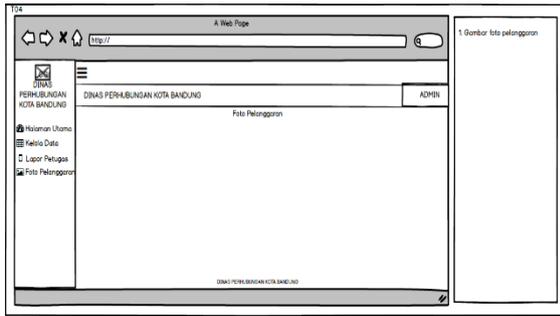


Figure 7. Page View Photos Violations

4.10.2 Menu Structure Design

Design of the menu structure is an illustration of the flow of system usage that has been made. The following is the design of the menu structure on the system can be seen in Figure 8

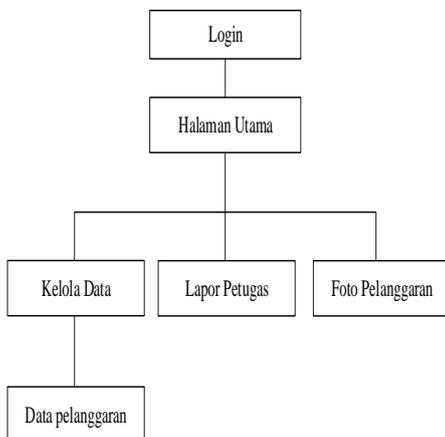


Figure 8. Menu Structure

4.10.3 Semantic Network

Semantic Network are graphics that show the relationship between objects that are interrelated with each other. The semantic network in the wild parking detection system can be seen in Figure 9.

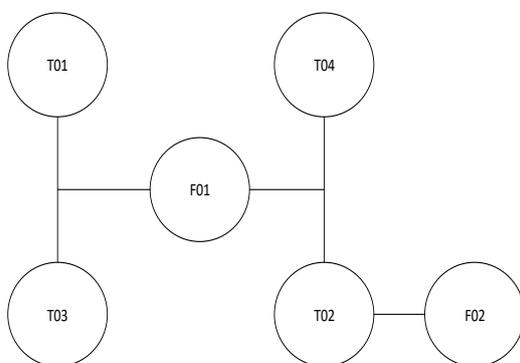


Figure 9. Semantic Network

4.11 Testing and Test Results

4.11.1 Blackbox Testing

Blackbox testing is a stage where every functionality of the system that has been made can run or not. Testing this system also functions to look for deficiencies that exist in the system created.

4.11.2 Test Results The testing tool

Test result is done by testing the tool used and checking the functionality of the system that has been made. The following are the cases and the results of testing the tools in the table 3

Table 3 Testing Tables of Tools

No	Tools	Case Test	Results According to Case Test	Remarks
1.	Camera	Detect s Object s	Testing is done by detecting vehicle objects. If successful, the camera can detect objects.	[√] Received [] Denied

following are the results of object detection tests can be seen in Figure 10.



Figure 10. Results of Detecting Objects

4.12 Blackbox Testing Results

Based on the results of the blackbox testing that has been done, it can be concluded that the wild parking detection system of vehicles in the Bandung City Department of Transportation has functionally produced the output as expected.

4.13 Interview Testing

Interview testing intends to test the system that has been made which is done directly to the research site to find out the results of existing goals. This test is also carried out by checking the running functionalities as well as data retrieval by conducting interviews with the Bandung City Department of Transportation officer, especially in the area of control and order transportation.

4.13.1 Scenario Testing Interview

Scenario interviews are conducted to find out each function of the system that has been made by conducting interviews directly to the research site.

4.14 Interview Testing Results

Based on the results of interviews conducted by employees and IT staff control and order transportation at teh Bandung City Department of Transportation, the conclusion can be drawn that the system created can help and facilitate the Bandung City Department of Transportation especially in the field of control and order transportation to monitor illegal parking violations in the city of Bandung.

5. CONCLUSION

Based on the results of research, analysis, system design, and testing directly at the research site with the interviews that have been conducted, the conclusions can be drawn as follows:

1. The vehicle parking wild detection system can help control and order transportation at the Bandung city transportation service to help see the condition of the road shoulder that is being used as a vehicle parking lot.
2. This vehicle's wild parking detection system can help to monitor illegal parking on the road.

Based on the tests that have been carried out, the suggestions needed to be taken into consideration in the future so that the system can be better are as follows:

1. Monitoring of illegal parking of vehicles should be carried out via smartphone for officers in the field.
2. Addition of other supporting tools such as sensors or the addition of cameras to the system that has been made so that the detection results can provide better information.
3. Reports of illegal parking violations should also be carried out by the society by making a mobile application that is directly connected to the admin.

REFERENCES

- [1] M. T. Sogen dan T. M. Kusuma, "RANCANG BANGUN PURWARUPA SISTEM PENDETEKSI KENDARAAN MENGGUNAKAN PUSTAKA OPENCV".
- [2] R. Sholikhin dan S. W. Mudjanarko, "ANALISIS KARAKTERISTIK PARKIR DI SATUAN RUANG PARKIR PASAR LARANGAN SIDOARJO," *Teknika : Engineering and Sains Journal*, vol. 1, no. 2, pp. 145-150, 2017.
- [3] O. K. Sulaiman dan A. Widarma, "SISTEM INTERNET OF THINGS (IoT) BERBASIS CLOUD COMPUTING DALAM KAMPUS AREA NETWORK".
- [4] S. A. Sidiq dan D. Irmawati, "PENGOLAHAN CITRA UNTUK IDENTIFIKASI TELUR BERDASARKAN UKURAN," *Jurnal Electronics, Informatics, and Vocational Education (ELINVO)* , vol. 1, no. 3, pp. 151-156, 2016.
- [5] Y. Permadi dan M. , "APLIKASI PENGOLAHAN CITRA UNTUK IDENTIFIKASI KEMATANGAN MENTIMUN BERDASARKAN TEKSTUR KULIT BUAH MENGGUNAKAN METODE EKSTRAKSI CIRI STATISTIL," *JURNAL INFORMATIKA*, vol. 9, no. 1, pp. 1028-1038, 2015.
- [6] "Welcome to Raspbian," [Online]. Available: <https://www.raspbian.org/>. [Accessed 11 November 2018].
- [7] "OpenCV," OpenCV, [Online]. Available: <https://opencv.org/about.html>. [Accessed 22 Desember 2018].
- [8] M. A. Afwani, E. Utami dan E. Pramono, "Modifikasi Default-Boxes Pada Model SSD Untuk Meningkatkan Keakuratan Deteksi," *Jurnal IT CIDA*, vol. 3, no. 2, pp. 33-40, 2017.
- [9] "Python," [Online]. Available: <https://www.python.org/doc/essays/blurb/>. [Accessed 29 Oktober 2018].
- [10] "What Is A Raspberry Pi," [Online]. Available: <https://www.raspberrypi.org/help/what-%20is-a-raspberry-pi/>. [Accessed 30 Oktober 2018].
- [11] L. A. Sanjani, S. J. Hartati dan P. Sudarmaningtyas, "RANCANG BANGUN

SISTEM INFORMASI PENGGAJIAN
PEGAWAI DAN REMUNERASI JASA
MEDIS PADA RUMAH SAKIT BEDAH
SURABAYA,” JSIKA, vol. 3, no. 1, pp. 87-93,
2014.

- [12] R. Susanto dan A. D. Andriana,
“PERBANDINGAN MODEL WATERFALL
DAN PROTOTYPING UNTUK
PENGEMBANGAN SISTEM INFORMASI,”
vol. 14, no. 1, pp. 41-46, 2016.