DEVELOPMENT OF TRANS BATAM BUS MONITORING SYSTEM BASED ON INTERNET OF THINGS IN DEPARTMENT TRANSPORTATION OF BATAM CITY

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ABSTRACT

This research aims to provide easier information access to Trans Batam bus users such as Trans Batam bus route information, information location of the bus and the estimated time of arrival of the bus at the bus stop. The method used is the prototype with the communication process, quick plan, quick design modeling, construction of the prototype and development of delivery and feedback. Utilization of the Global Position System (GPS) as a source of data for the presence of the bus will then be sent to the webserver by NodeMCU and Bluetooth Low Energy (BLE) as a source of bus arrival data that sends Bluetooth signals and will be received by the Raspberry Pi upon arrival at the bus stop, as well as the application website based as an interface for Trans Batam bus users. The use of NodeMCU and Raspberry Pi here aims as a data communication center that will transmit data from the Global Position System (GPS) and Bluetooth Low Energy (BLE) wirelessly to the webserver. This Trans Batam Bus Monitoring system based on Internet of Things can facilitate Trans Batam bus users in getting information about the bus.

Keywords: Monitoring, Internet of Things, Trans Batam, Public Transportation, Global Position System (GPS)

1. INTRODUCTION

Transportation has become the most important element in the development of development in Indonesia [1]. Public transportation plays an important role in supporting daily living. Batam Bus Stop and Bus is a means and infrastructure of public transportation, of course, must provide optimal functions. One of them can provide value benefits for public transportation users.

However, judging from the fact that there are people having difficulty in getting information about the bus. Difficulties such as knowing about the Trans Batam Bus Route and estimated time of arrival of the bus at the bus stop.

Based on observations made by riding the Trans Batam Bus, it can also be seen in the bus that there is no information about the bus stop at the next stop that is being headed and the estimated time the bus will arrive at the stop that is being addressed.

Therefore to realize this the author intends to build a trans batam bus monitoring system tool as the writing of the final project entitled "Development of the Batam-based Trans Batam Bus Monitoring System of Things in Batam City Transportation Agency" which aims to facilitate Trans Batam Bus users.

1.1. Prototype

The software development method uses a prototyping model, because in making this system the user involvement is very high so the system meets the user needs better [2].

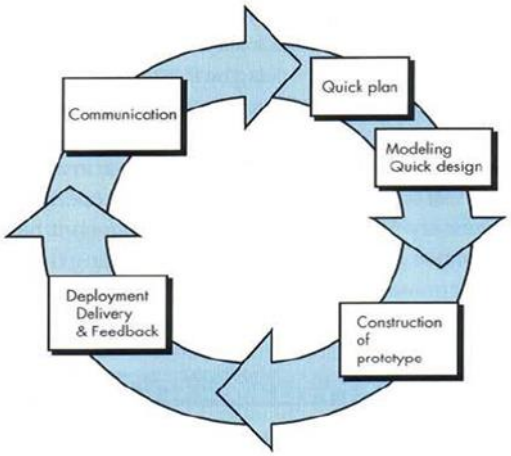

Figure 1. Prototype Model [3]

Explanation of the prototype model point is as follows:

1. Communication
   At this stage an analysis of the problem was carried out by conducting interviews with Batam City transportation department staff and several trans batam bus users in Batam City. Then after that, I will carry out an analysis to identify all the needs and specifications of the needs to be made.
2. Quick Plan
   At this stage the prototype design was carried out quickly by making a temporary design based on the analysis of the problems obtained after conducting interviews with Batam City

transportation service staff and some trans batam bus users in Batam City and the need to establish an Internet-based Trans Batam Bus monitoring system. .

3. Modeling, Quick Design
   At this stage, prototype modeling is carried out. The process of making a design model to assist in making the system.
4. Construction of Prototype
   At this stage prototyping models are evaluated according to user needs based on designs that have been modeled before.
5. Deployment, Delivery & Feedback
   At this stage, the prototype was tested by Trans Batam Bus users. The response from the user is used to perfect the system according to user needs. Development is carried out so that the prototype can be improved to satisfy the needs of the user. If the user is satisfied with the prototype to be developed, the system is developed based on the final prototype.

2. RESEARCH CONTENTS

1.1 Definition System

The system is a collection of elements that interact to achieve a certain goal. this system describes a real event and unity is a real object, such as places, objects, and people who actually exist and occur[4].

1.1.1 Monitoring System

A monitoring system is a collection of several processes that are made into a single unit and integrated with each other to be able to collect data from an event and display the data intact or data that has been processed. The stages in the monitroing system consist of 3 processes, as follows:

1. Data collection process
2. Data analysis process
3. The process of displaying data

Between the two action processes there is a service that continues to run at a certain time. The process runs in realtime during the monitoring process. From every monitoring process, it will start with data collection such as speed data, slope data and others. After the data is collected, the data will be processed or analyzed in advance such as filtering, selecting and others. After the analysis process the data display process will be carried out. Showing data can be in the form of curves, graphs, tables or pictures or videos.

The purpose of monitoring is to find out and study the data reported in accordance with existing realities and to identify problems that arise so that they can be overcome[5]. So that by doing monotoring, all problems that arise can be immediately addressed appropriately.

1.2 Intenet of Things

Internet of Things (IoT) consists of 2 main pillars namely "internet" and "Things", so every object that is able to connect to the internet will fall into the "Things" category as it includes a set of more general entities such as smartphones, sensors, humans and other object. The context is able to communicate with other entities, making it accessible anytime, anywhere. Broadly speaking with the Internet of Things (IoT) objects must be accessible without limitation of time or place [6].

In making this final project the concept of the Internet of Things is used to provide easier access to Trans Batam Bus users.

1.3 Raspberry Pi

Raspberry Pi is a single board computer (Single Board Circuit / SSC). Or a mini computer that has the size of a credit card. Raspberry Pi is very useful for various purposes, such as spreadsheets, games, playing high definition video. Raspberry Pi was developed by the Nirbala Foundation, the Raspberry Pi Foundation, which is managed by developers and computer experts from the University of Cambridge, England.[7].

Figure 2. Raspberry Pi 3 Model B

1.4 Global Positioning System(GPS)

Global Positioning System (GPS) is a satellite-based radio navigation system developed and operated by the United States Department of Defense. The GPS receiver uses satellite signals to triangulate the position to be determined by measuring the length of time the signal is sent from the satellite, then multiplying it by the speed of light (3x108 meters / second) to determine exactly how far the GPS receiver from each satellite is, using signals sent by the satellite at least three signals from different satellites, the GPS receiver can calculate the fixed position of a point that is the position of latitude (latitude) and longitude of the earth (longitude). The use of the fourth satellite signal allows the GPS receiver to calculate the position of the height of the point against the average sea level and this condition is ideal for navigation[8].

Figure 3. Global Positioning System (GPS) Sensor

1.5 Bluetooth Low Energy(BLE)

Bluetooth low energy (BLE) Is the latest technology from bluetooth that is smarter than the previous version and is often referred to as smart Bluetooth. BLE was originally designed by Nokia with core 4.0 to create a radio standard that has a fairly low power consumption, low cost, low installation, easy, and the bandwidth is quite low[9].

Figure 4. Bluetooth Low Energy(BLE) Module

1.6 System Analysis

Systems analysis can be defined as the decomposition of a whole system into its component parts with a view to identifying and evaluating existing problems, constraints and expected needs.

1.6.1 Analisis Masalah Problem analysis

Development of the IoT trans bus based monitoring system based on the Raspberry Pi as a microcontroller, as well as a web-based application as an interface to provide information about the bus so as to provide convenience for trans batam bus users. Based on the results of research that has been done, there are several problems found, as follows:

1. Trans batam bus users cannot find information about the bus, because there is no information board about the bus at the bus stop.
2. Users who are on the bus cannot find out the information of the bus being ridden because the running text and monitor contained in each bus cannot provide information about each bus.

1.6.2 Analysis of Current Procedures

Analysis of the running system is the stage for analyzing procedures in the form of an appropriate sequence of activities carried out such as what processes are carried out, who is working on the process, how the process can be done and what is involved from the system that runs from how to use batam trans bus.

The procedure flow is as follows:

1. Trans batam bus users come to the bus stop.
2. Trans batam bus users make ticket purchases.
3. Trans batam bus users are waiting for the bus to arrive.
4. If the bus arrives late, the officer will inform the Trans Batam bus user.

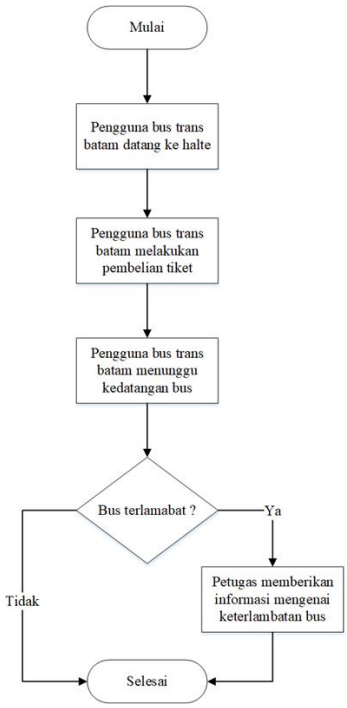

Figure 5. Prosedur yang Berjalan

1.6.3 Systems Architecture Analysis

System architecture analysis is a process to describe the physical system to be built and also its supporting components. The following is an overview of the system architecture to be built as in Figure 6.

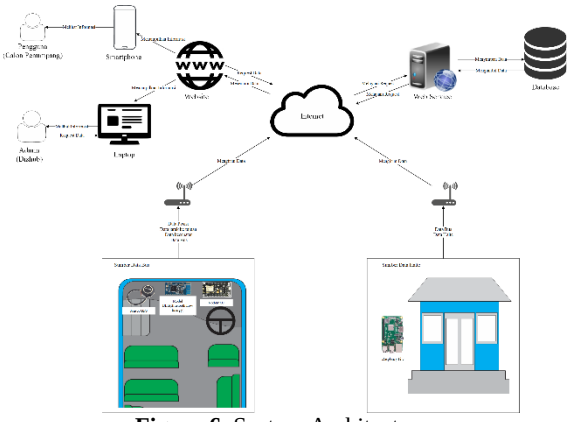

Figure 6. System Architecture

The system architecture above explains how the system will run later, for an explanation will be detailed in the following points:

1. SensorAGPS Neo 7M will get position data of distance to destination and speed.
2. The Bluetooth low energy (BLE) module sends a Bluetooth signal upon arrival at the bus stop.
3. Raspberry Pi and NodeMCU receive bluetooth signals from the BLE Module (Bluetooth Low Energy).
4. Data obtained by the Neo 7M GPS Sensor will be processed and sent to the web server wirelessly via NodeMCU.
5. Data obtained by Raspberry Pi will be processed and sent to the web server wirelessly.
6. The data obtained is forwarded to the web server via the internet network.
7. The web server will store data buses that arrive at the bus stop into the database.
8. Then the results of this monitoring tool are displayed on a website that can be accessed via a computer and smartphone.

1.6.4 Data Communications Analysis

Data communication is a very important thing, because without data communication, an application that is built will not be able to run properly or optimally. Following is an explanation of the 3 main elements in data communication systems as follows:

1. Data Sources
   Neo-7M GPS Sensor, Bluetooth Low Energy Module (BLE).
2. Transmission Media
   Raspberry Pi 3, NodeMCU.
3. Data Receiver
   The website.

1.6.5 Use Case Diagram

Use Case Diagram is modeling for information systems that will be made. Next in Figure 7.

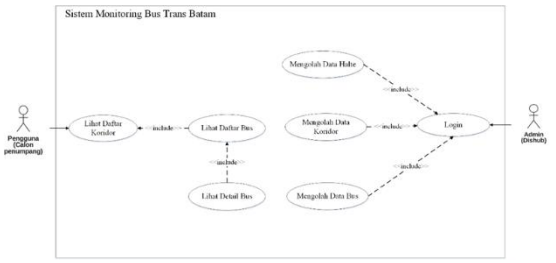

Figure 7. Use Case Diagram

1.6.6 Class Diagram

Class Diagram is a specification of functionality that produces objects and is the core of the development of this application [10]. Class diagram of the Trans Batam bus monitoring system, for more details can be seen in Figure 8.

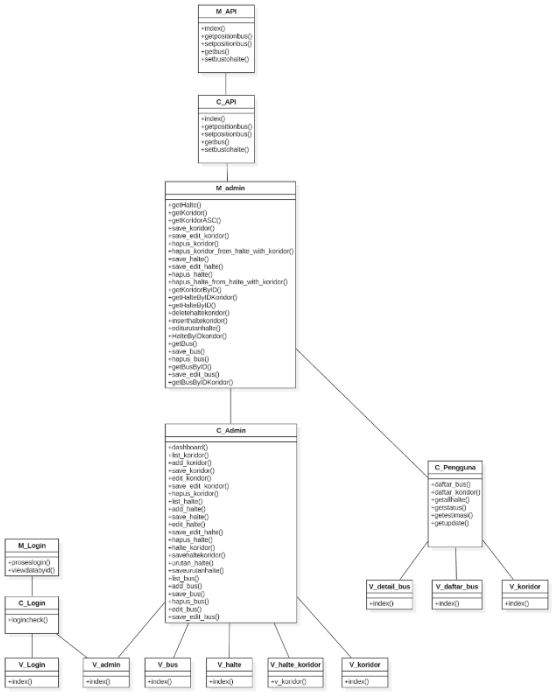

Figure 8. Class Diagram

1.7 System Testing

System testing is the most important thing that aims to find errors or deficiencies in the information system being tested. System testing is intended to determine the performance of information systems that have been made in accordance with the objectives of information system design. The types of testing carried out include Testing Functionality and Usability.

1.8 Black Box Testing

Black box testing focuses on whether the software built meets the requirements mentioned in the specifications. Tests carried out by running or executing units, then observed whether the results of the units tested are in accordance with what is expected or not.

1.9 Black Box Testing Scenarios

Software testing scenarios on the internet monitoring system of trans batam based on things can be seen in Table 1.

Table 1. Black Box Testing Scenarios

Test Case	Testing Details	Types of Testing
Admin Login	User Login	Black Box
Bus Data for Admin	View, add, delete, edit bus data	Black Box
The Bus Stop Data for Admin	View, add, delete, edit the bus stop data	Black box
Corridor Data for Admin	View, add, delete, edit corridor data	Black box
List of Corridor fo Users	View list corridor	Black Box
View Bus Details for Users	View bus monitoring	Black Box

1.10 Conclusion Black Box Testing

Based on the results of Black Box testing that has been done, it can be concluded that functionally all processes in the system have been partly running as expected.

1.11 Hardware Testing

Hardware testing aims to ensure that the hardware can work and is of good quality.

1.11.1 Testing of the Neo-7M GPS Sensor

Neo-7M GPS sensor is a sensor used to determine position data, distance to the destination and the speed of the bus. Temperature and humidity, the Neo-7M GPS sensor is stored in a black box with NodeMCU as the microcontroller.

Figure 9. Testing of the Neo-7M GPS Sensor

From Figure 9. it can be seen that the gps sensor can work well, where the bus marker on the map moves forward or moves position although the test results obtained are not too accurate on the map's position.

1.11.2 Testing of The Bluetooth Low Energy(BLE) Module

Modul BLE (Bluetooth Low Energy) is a module used to transmit Bluetooth signals that will be received by the Raspberry Pi. This BLE (Bluetooth Low Energy) module has a different User ID than, this User ID is unique so each module has a different User ID. Testing the BLE (Bluetooth Low Energy) module is done by tapping it on the bus that the Bluetooth signal will receive by the Raspberry Pi upon arrival at the bus stop.

Table 2. Condition if Bluetooth Low Energy Detected

BLE detected at th bus stop () name: BT05, address: 00: 15: 85: 14: 9C: 09 {"status": "successful"} ('insert bus to stop:', u 'worked') ()

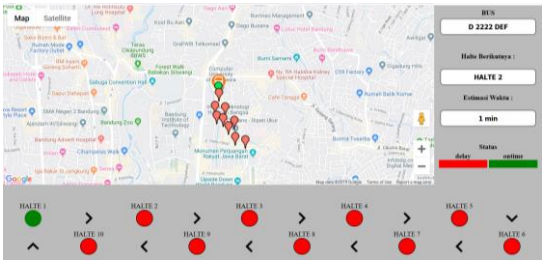

Figure 10. Testing of The Bluetooth Low Energy Module

From Figure 10. it can be seen that the BLE (Bluetooth Low Energy) module can work well, the BLE (Bluetooth Low Energy) located on the bus has a User ID: 00: 15: 85: 14: 9C: 09 received its bluetooth signal by raspberries pi is located on the stop so the stop marker and the HALTE 1 icon below the map turn green.

1.12 Beta Testing

Beta testing was conducted to determine the assessment of the Trans Batam Bus Monitoring based on the Internet of Things that was built using the interview method.

Table 3. Beta Testing Interview

No	Question	Answer
1	Can you use the trans batam bus monitoring system based on IoT to get information about bus routes, bus estimations and bus stops to go to?	Yes, I can receive the information. The information obtained is also quite clear and accurate. Only for GPS is not as accurate as GPS on smartphones. But overall the information can be received.

2	Does using the trans bus monitoring system based on IoT help you to more easily ride the trans batam bus?	Yes, this is very helpful, so I can know when the bus will arrive at the bus stop and it has arrived at which bus stop I am on.
3	Can this trans batam bus monitoring system based on IoT be used easily and according to its purpose or need?	Quite easy, simple and clear enough information, according to the same needs.

3. FINALITY

3.1 Conclusions

Based on the results of software and hardware testing that has been made as a trans batam bus monitoring system, the following conclusions are obtained:

1. The system that has been built can provide information to trans batam bus users through a website that can be accessed via a smartphone about buses such as the trans batam bus route map, the number of trans batam bus corridors, bus locations, estimated bus arrivals at stops and destination stops being addressed by bus.
2. The system that has been built can provide information to trans batam bus users while on the bus about the location of the bus, the next stop and estimated travel time to the next stop via the display contained on the bus.

3.2 Suggestions

System that has been made still needs to be developed again in the future, so that the system that has been built can work even better. The suggestions for developing software that is built are as follows:

1. The system can provide more accurate bus presence information.
2. Develop a platform that can be supported by other software, considering that currently only supports the web.
3. Use sensors that are truly capable of running properly, in order to obtain satisfactory results.

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