

Android Application of Booking System of Parking Slot using MQTT Protocol

Muhammad Khoirul Hasin*, Angellia Kusuma Putri, Muhammad Basuki Rahmat, Ryan Yudha Adhitya
Politeknik Perkapalan Negeri Surabaya
Surabaya, Indonesia

*khoirul.hasin@ppns.ac.id, angelliakp19@gmail.com, mbasuki.rahmat@ppns.ac.id, khoirul.hasin@ppns.ac.id

Abstract—Every year the growth of the number of people in Indonesia continues to increase, then this situation is not accompanied by a safe, convenient, and nearest parking location to the destination location, this is what triggers a number of problems that develop in the community. Due to the increasingly dense number of vehicles there will automatically make people difficult in finding parking locations. Seeing these needs, the authors created an application technology that helps facilitate the public in finding a parking location as needed. By utilizing Android and Web applications with non-cash payment features that are developing in today's society using the MQTT communication protocol that is applied to the Internet of Things empty parking location slots can be monitored and ordered and paid for by the public quickly and easily. The main purpose of making this application is expected to assist users in finding parking locations by utilizing the Android application and providing preventive measures in reducing the use of paper as a parking ticket replaced by a QR code.

Keywords—parking location, android, web, MQTT

I. INTRODUCTION

The number of population growth in Indonesia has increased significantly every year. Based on data from the Central Statistics Agency in 2018, the population of Indonesia is 265 million, an increase of 11.55% of the population in 2010. Of the 265 million population in Indonesia, 111,571,239 units of vehicles have been registered in Indonesia based on data from Mabel Polri as of January 1, 2018. In addition, the mass transportation system in Indonesia, which until now has been inadequate as well as some convenience for the public today to have a private vehicle by credit, which is only enough to capitalize KTP and KK is one of the reasons many people choose to use Private vehicles which caused an increase in the volume of private vehicles, it was noted that the use of motorized vehicles in Indonesia increased by 11% every year. It is unfortunate, the many ownerships of vehicles operating in.

Indonesia are not matched by the availability of parking lots, which in turn makes people park vehicles in any place, this can be a trigger for traffic jams, vehicle loss, vehicle damage in the parking lot, parking fees arbitrarily by carvers (parking attendants) and the driver parks the vehicle far from the destination location.

Utilizing the MQTT communication protocol that is applied to the Internet of Things can work even though it is in a weak signal due to parking lots that are generally located in basements or closed buildings [1].

Related research has been done before by Saputra [2] entitled Application of the MQTT Protocol on WAN Technology, in this study Using two different methods, namely, the MQTT and RPC methods to design a system that can inform the state of the car park quota, in the first method that is, MQTT there are three topics that will be followed by subscribers, publishers and brokers. The use of the second method is RPC where there are 2 components, namely client and server. Of the two methods will be combined into a full system that will provide information on the state of the parking space of each existing parking space will then be sent to the publisher. After being collected by the publisher, information will be submitted to the subscriber according to the desired topic through the broker. In this study the author uses MQTT communication protocol because it only sends packets of 2 Bytes so that it does not overload internet network resources, due to the nature of the simple and efficient MQTT protocol. MQTT Communication Protocol is also equipped with several features that support it. The following MQTT Protocol features.

- Publish / Subscribe messages from one to many and decoupling the application.
- Agnostic messaging messaging with the contents of the payload.
- Using TCP / IP as basic network connectivity.

There are three levels of Qualities of Service (QoS) in delivering messages. The IoT device monitoring system is developed using the MQTT protocol. This protocol is considered in accordance with IoT devices that are light weighted messages and is designed on devices with minimum resources. The publish / subscribe principle of the MQTT protocol can adapt in sending and receiving messages when monitoring based on a customized topic. Reviewing some of the disadvantages and strengths of the MQTT Communication Protocol above, the following underlie the authors using MQTT:

- Even if the internet connection is lost one time all messages are guaranteed to be sent by MQTT.
- MQTT is still able to send messages properly in a state of a weak connection signal, assuming the location of the parking located in the basement.
- The Communication Protocol MQTT has proven to be more efficient and lightweight for use in communication.

II. SYSTEM DESIGN

Developing a controlling and monitoring system of IoT devices requires a number of good and appropriate reference sources, it can be obtained from journal books and research studies that have been carried out by others as a reference for writers in the design and implementation stages. Important grounds in this research include, Arduino Mega 2560, Nodemcu, MQTT protocol, Obstacle Sensor, Servo Motor, Mosquitto, LED Indicators, Buzzer, and network monitoring. Prototype Design for simulation as a parking location using a microcontroller which consists of several input devices, namely IR Obstacle sensors, amounting to 8 pieces, 6 as a reader of the parking lot condition and as a parking doorstep, servo motor as a parking gate, then a process device consisting of Arduino Mega 2560 and the output or output device consisting of LED lights and Buzzer as an alarm indicator for users who park in the wrong place. The following block diagram is related to system design.

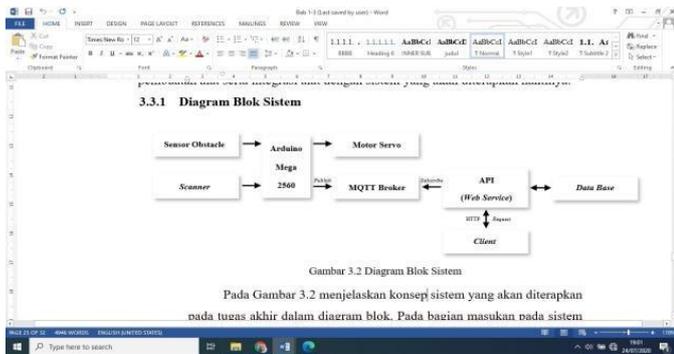


Fig. 1. System block diagram.

The figure 1 block diagram above has an input part, a process part and an output part and there are also some supporting hardware that helps system performance. The hardware is like a servo motor, LED lights, Buzzer and Obstacle sensors. This supporting hardware will help complete system performance because the hardware has a special function to optimize the work of the system being designed.

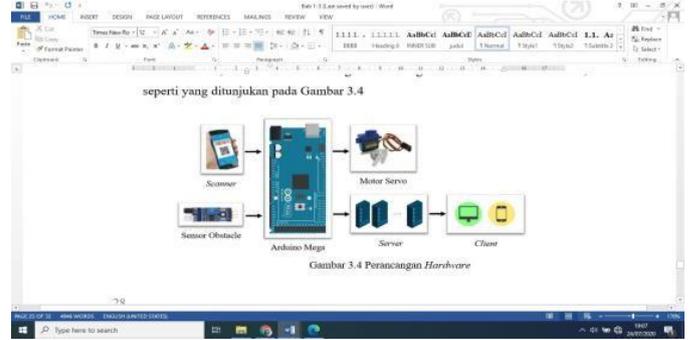


Fig. 2. Hardware system installation.

In figure 2 above, describe the system hardware installation that will be made with some of the following components:

A. Arduino Mega 2560

Arduino is an open-source physical computing platform based on a simple i / o board that has 54 digital PWM input / output pins, 16 pin as analog input, and 4 pin as UART (serial hardware port), 16 MHz crystal oscillator, USB connection, power jack, ICSP header, and reset button. For relatively simple use, just connect the power from USB to PC / Laptop or via DC Jack using adapter 7-12 V.



Fig. 3. Arduino Mega 2560.

Arduino Mega 2560 as shown in Figure 3. has a facility to be able to communicate with computers, other Arduino, or other microcontrollers. In the system that has been designed using the Arduino Mega 2560 to drive the servo motor as a parking doorstep.

B. NodeMCU

NodeMCU is an IoT platform that is open source. Consists of hardware in the form of System on Chip ESP8266 from ESP8266 made by Expressive System.

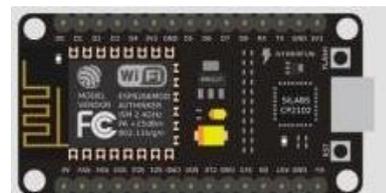


Fig. 4. NodeMCU.

In figure 4. shows the Nodemcu used in this study to receive data sent by the website and application through the MQTT Protocol, as well as communication in the form of serial data to the Arduino used.

C. Maintaining the Integrity of the Specifications

Message Queue Telemetry Transport or commonly called MQTT is a protocol for machine to machine or M2M communication and works at the seventh layer or application and is lightweight message. Even if the connection is lost, all messages sent will be guaranteed by the MQTT protocol. The publish / subscribe communication method is the sending method used by the MQTT protocol. The message on MQTT is sent to the broker and contains the topic sent by the publisher. Then the topic was processed to be forwarded to the subscriber based on user requests.

D. Maintaining the Integrity of the Specifications

The Obstacle IR Sensor is a sensor that can detect obstacles using reflected infrared light. This sensor has two main parts, namely IR emitter and IR receiver.



Fig. 5. IR Obstacle sensor.

In Figure 5. shows the Obstacle sensor used where the Emitter is tasked to reflect infrared to the obstacle or the object will then be reflected and received by the receiver. When infrared hits an object, the condition will LOW and HIGH.

E. Servo Motor

Servo systems require a drive in the form of a motor. The type of motor used is a servo motor which is usually used as a driving controller for the position of the robot arm.

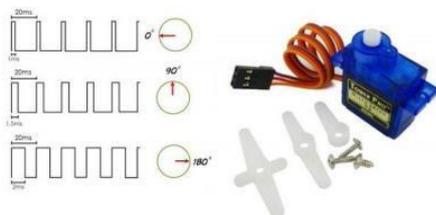


Fig. 6. Servo Motor.

The working principle of the servo motor as shown in Figure 6. To move the servo angle of 180 ° requires adjusting

the pulse width of 2ms and pulse width of 1ms to move the angle of the servo by 0°. Servo motor is a dc motor that has a series of electronic controls and internal gear to control the movement of angular angles. Servo motor is a motor that is able to move both ways, clockwise (CW) and counterclockwise with current clockwise (CCW).

F. Mosquitto

Eclipse Mosquitto is a Message broker that implements the MQTT protocol versions 3.1 and 3.1.1. From the official site, Mosquitto, has supported various operating systems ranging from Mac OS, Microsoft Windows, and various Linux distribution variants. First the Broker will accept a CONNECT request from the client and give a CONNACK (Connect Acknowledge) feedback. As one of the frameworks with lightweight categories, there are other uses for flasks, which are good capabilities when integrated with SQLAlchemy in the database. This capability can maximize the performance of applications that use databases to store a large amount of data.

G. LED Indicator

LED Light Emitting Diode indicators or often abbreviated as LEDs are electronic components that can emit monochromatic light when applied forward voltage. LED is a family of diodes made from semiconductor materials.



Fig. 7. Red LED indicator.

Figure 7 shows the color of the LED used in this study, which is red that is often found in alarms. The colors of the light emitted by the LED depend on the type of semiconductor material used.

H. Buzzer

Buzzer is an electronic component that functions to convert electrical vibrations into sound vibrations.



Fig. 8. Buzzer.

In figure 8 the buzzer used basically has a working principle that is almost the same as the loud speaker. Buzzer also consists of windings that are attached to the diaphragm and then these windings are flowed so that they become electromagnets, these windings will be pulled in or out, depending on the direction of the current and the magnetic polarity, because the coil is mounted on the diaphragm, each coil motion will move the diaphragm back and forth. thus making the air vibrate which will produce sound.

I. Network Monitoring

Monitoring on the network is the ability to observe, control and take analysis on a system or on a computer network. The important point is the process of monitoring on a computer or other device. The basic concept of management on this network is the presence of an agent that is all types of devices that can be observed and a manager that is a device that runs the monitoring process.

III. THE WORKING OF SYSTEM

The workings of this system starts from the user who has booked a parking slot on the user's Android application and then the user will get a QR code to open the entrance and exit lane in the parking location, after entering the user will find out and occupy the correct parking slot by detecting with a QRcode scan parking dislot, if the user parked in the wrong place the alarm will be activated by sending a customized topic, then the IR Obstacle sensor works as a detection of the vehicle in the parking lot to turn off the alarm when the vehicle has moved. Then the admin website is used to monitor user activity from the message to the parking location.

A. Implementation

In the implementation phase at the publisher the draft has been adjusted to the parking location and has been implemented. There are 6 slots and two door bars for access in and out. Arduino software is used as a programming language to retrieve data in the monitoring process. Prototypes that have been made are adjusted and implemented.

TABLE I. SERVO MOTOR CONNECTIVITY TABLE

Arduino	Servo Motor 1	Servo Motor 2
2	Data	-
3	-	Data
GND	GND	GND
V IN	+5 Vdc	+5 Vdc

In the table above we get data from the servo motor used as a doorstop, there are two servo motors used for access in and out. The following is the alarm connectivity table.

TABLE II. BUZZER CONNECTIVITY TABLE

Ard	Buz1	Buz2	Buz3	Buz4	Buz5	Buz6
5	Data					
7		Data				
9			Data			
11				Data		
22					Data	
26						Data
GND	GND	GND	GND	GND	GND	GND

From tables 1 and 2 the data obtained is a topic for bars and alarms, namely:

Gate : "enter" and "quit"

Alarm : "on" and "off"

After monitoring results are obtained, the data will be changed as topics, then the broker will receive a message in the format. In the implementation there is a Mosquitto broker that functions to receive data from the publisher later, sending the topic to the subscriber according to the request. Furthermore, the data received by the subscriber is stored in a database, then the data will be processed and displayed in the admin web application.

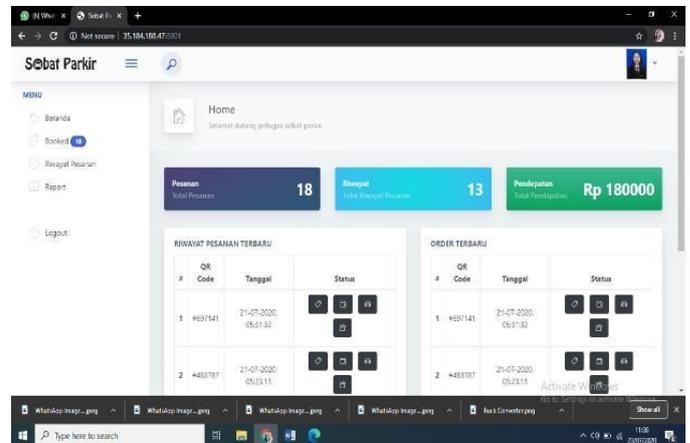


Fig. 9. Main page of the Admin Web.

The admin web page is shown in Figure 9. It is an activity monitoring page and admin financial report, which is contained in the IoT Monitoring System, which is an order and history feature that can monitor the activities of application users in real-time. On this page there are several icons that are a sign of user activity when making a slot order, have made a slot payment transaction, have parked the correct dislot, and exited the parking location. Previously, parking slots can be ordered by application users who have logged in and registered.

B. Units

The stages that are passed when the implementation process is completed are testing and analyzing the running system. Various kinds of tests are carried out, among others, testing the sensors used for the prototype, testing the performance of the

system, testing the functions of the application, testing the amount of delay in integrating the prototype with the system. In testing the sensor that will be used on the author's prototype using Arduino software, the sensor being tested is a servo motor to get the right angle and the Obstacle sensor and also the Buzzer as an alarm. Then the next test is to test the performance of the application so that it runs according to the compiled flowchart and records the delay and error values that may occur. And the last is to test the process of integration of communication between applications and prototypes that have been prepared.

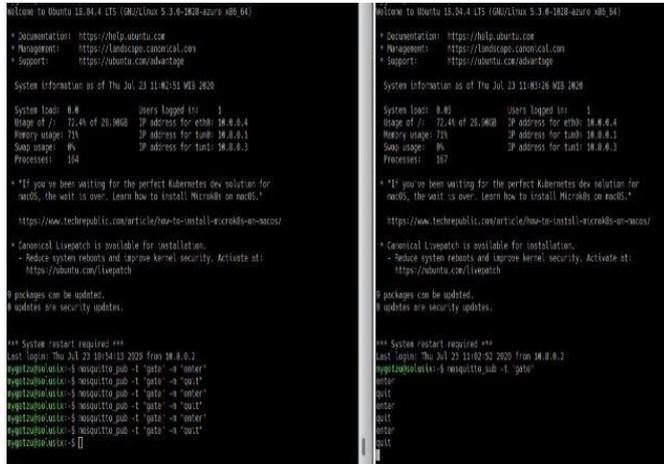


Fig. 10. Publish results subscribe to the Alarm Topic.

In figure 10 above it can be observed that the predetermined alarm topic can be published and subscribed by the system, so that when the user parks in the wrong place the alarm will light up to remind the user.

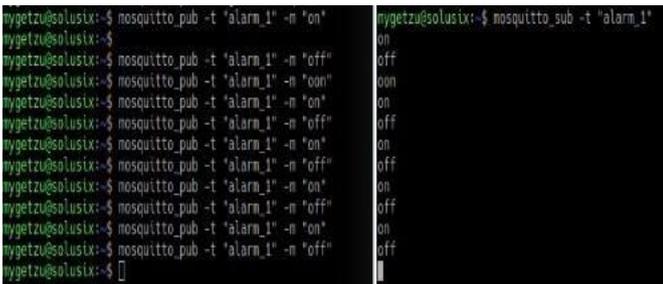


Fig. 11. Results of publish subscribe to gate topics.

In figure 11 below, it can be observed that the topic of the predetermined parking doorstop can be published and subscribed by the system, so that when the user's QR code is scanned by the official upon arrival at the parking gate the doorstop will open and reappear after the user has passed it.

```
1 SELECT * FROM public.building_location
2
```

	Data Output	Explain	Messages	Notifications
	id [PK] integer	location character varying	mallid integer	
1	1	Gedung A Lantai 1	1	1
2	2	Gedung A Lantai 2	1	1
3	3	Gedung A Lantai 3	1	1
4	4	Gedung B Lantai 1	1	1
5	5	Gedung B Lantai 2	1	1
6	6	Gedung B Lantai 3	1	1
7	7	Gedung C Lantai 1	1	1
8	8	Gedung C Lantai 2	1	1
9	9	Gedung C Lantai 3	1	1
10	10	Gedung D Lantai 1	1	1

Fig. 12. Results in database.

Figure 12 the above is the result of data in the Database that can be seen information on each slot and id of each slot, there is also a menu to show the location of each parking slotto lock each parking slot so that there is no double order by other users.

The user application is tested to find out whether the application is running well and produces an output value in accordance with the wishes of the user, so that when a user has ordered a slot then other users cannot place an order in the same slot, but when the slot is canceled and available, other users can order these slots. Furthermore, the web admin is tested to find out whether the web application is running well and produces output values in accordance with the wishes of the user, so that the web admin can display order history along with the time of ordering and user activity and daily and monthly reports. This trial is conducted to test whether the application and the web are able to display data that has been processed.

At the last stage in testing that is about testing on QoS, namely delay and throughput. Based on calculations obtained when testing the value of delay and throughput of the MQTT protocol on the IoT device monitoring system is not too large. Through these observations it can be concluded that the MQTT protocol used by the IoT device monitoring system is capable of running with low bandwidth and high latency conditions.

IV. CONCLUSION

The MQTT protocol used is able to run well and smoothly when implemented in the IoT device monitoring system of parking locations which are generally in closed locations such as basements. The publish-subscribe principle that is applied can work well in the data transfer process that has been done and obtained a topic that contains information needed by the user based on observations from the specified device. Also concluded that the resources in the MQTT protocol can work well in low bandwidth conditions and high latency.

REFERENCES

- [1] G.Y. Saputra, "Penerapan Protokol MQTT Pada Teknologi WAN (Studi Kasus Sistem Parkir Universitas Brawijaya)" Proc. 2017 2nd Int. Conf. Front. Sensors Technol. ICFST 2017, vol. 2017– Septe, pp. 1858-4853, 2017.
- [2] G.Y. Saputra, "Penerapan Protokol MQTT Pada Teknologi WAN (Studi Kasus Sistem Parkir Universitas Brawijaya)" Proc. 2017 2nd Int. Conf. Front. Sensors Technol. ICFST 2017, vol. 2017– Septe, pp. 1858-4853, 2017.