Emerging Information Science and Technology
Vol. 2, No. 2, (2021), pp. 46-56

Water Level Monitoring System Simulation Using Flutter Framework In Pekalongan City

Gilang Hendra Dita Edifianto*, Cahya Damarjati, Asroni
Universitas Muhammadiyah Yogyakarta, Jln.Brawijaya, Tamantirto, Kasihan, Bantul, Yogyakarta 55183, Indonesia
**Corresponding author: ditogilang17@gmail.com*

Abstract

Pekalongan City is a region on the northern coast of Java with a sloping topography and is susceptible to the increasing sea level, which can result in tidal floods. As previous research revealed, ten villages in three districts, including coastal areas, are vulnerable to tidal floods. Moreover, the vulnerability analysis based on BNPB Head Regulation (Perka) No. 2 of 2012 unveiled that seven out of ten villages in three districts have a high risk of tidal floods. Pekalongan City experienced a tidal flood that swamped 16 villages in three districts at the beginning of 2021. It was the result of heavy rains and strong tides along the northern shore. The tidal flood caused damage to a variety of sectors, including agriculture, communities, infrastructure, and clean water sanitation. Information technology development was employed in disaster management, making it simpler to acquire data for predicting future disasters, obtaining data in disaster-affected areas, and implementing mitigation in disaster-prone areas. This study collected data through interviews and a literature review. This research created Android applications simulating a water level monitoring system using the flutter framework. Firebase was utilized as a database for authentication, while Google Maps Platform was deployed to display maps during the application simulation. It is anticipated that the simulation of the water level monitoring system will be the first step in building the water level monitoring system in Pekalongan City. Hence, residents of Pekalongan City can utilize it to assist with mobility issues during floods.

Keywords: *Android, Flutter, Google Maps Platform, Firebase, Pekalongan City, Tidal Flood,Simulation*

1. Introduction

Climatic change is a phenomenon that alters long-lasting climate trends and weather patterns. This occurrence is a result of the greenhouse effect generated by human activity. Climatic change influences rapid shifts in climate patterns. Coastal areas are vulnerable to tidal floods due to climate change uncertainty. Researchers performed currently, the amount of coastal floods, also known as tidal floods, in the northern coastal region of Java Island is likely a result of changes in sea level caused by global warming [1].

Pekalongan City is located on the north coast of Java and is vulnerable to increasing sea levels due to its sloping topography. It is susceptible to tidal floods because of its exposure to seawater. Researchers performed, ten villages in three districts, including coastal areas, have susceptibility to tidal floods, and the results of vulnerability analysis based on BNPB Head Regulation (Perka) No. 2 of 2012 disclosed that seven out of ten villages in three districts have high vulnerability to tidal floods [2].

Researchers performed information compiled from Tirto.id unveiled that Pekalongan encountered a tidal flood in early 2021, inundating 16 villages in three districts to a depth of 10 to 100 centimeter [3]. Researchers performed The Head of Disaster Prevention and Preparedness for BPBD of Pekalongan City, Dimas Arga Yudha, asserted that the flood in Pekalongan was caused by heavy rainfall, tidal waves from the north shore, and high river flow upstream [4].

The tidal flood in Pekalongan City caused damage to several sectors, including agriculture, settlements, and infrastructure. Adaptation to tidal floods in communities includes inhabitants elevating their homes or constructing dikes. In the infrastructure sector, adaptation measures cover elevating roadways and floors in public amenities buildings. Researchers performed the selection of seeds, the installation of nets, and the creation of cactus washing baths are sanitation and agricultural sector modifications [5]. Due to the inaccessibility of roads created by pools of water, the Pekalongan people's mobility decreased due to the tidal flood.

Today's information technology advances make gathering information for disaster management easier. The use of information technology in disaster management can aid in predicting future disasters, make it simpler to collect information in disaster-affected areas and improve the execution of mitigation in disaster-prone areas. Information technology can be utilized effectively in disaster management as long as it is deployed, implemented, and directed appropriately.

Given the context, a water level monitoring system in Pekalongan City is required, particularly in coastal areas. This information system's development can provide map-based water level monitoring stations. However, this study created a simulation, the first stage in creating a water level monitoring system for Pekalongan. By creating a simulation of a water level monitoring system in Pekalongan City, it is intended that the system be considered for implementation later to assist the residents with mobility issues during floods.

Researchers performed with the title "WebGIS Implementation for Mapping West Jakarta City Tourism Objects with the Location Based Service Method using the Google Maps API" conducted research by developing webGIS using the CodeIgniter framework which displays tours in West Jakarta which are accessed via browser. This study conducted tests by conducting usability tests. The results of this study indicate that the usability of the West Jakarta tourism webGIS is in the "effective enough" category [6]. Researchers performed entitled "Utilization of Google Maps Technology for Android-Based Crime-Prone Location Detection Applications in East Praya District, Central Lombok Regency" conducted research by developing an Android-based mobileSIG aimed at mapping crime-prone areas in East Praya District, Central Lombok Regency [7]. From the literature review it can be concluded that the similarities between the articles above and this research are: This research develops an application that uses a map service to display information. This research uses a cloud-based map service, namely Google Maps. In the literature review there are also differences from the literature review, namely: This study develops a water level monitoring simulation using the Flutter framework. This study did not use a water level detection device to obtain monitoring data.

2. Method

Data gathering and development methods were employed in this study.

2.1. Data Gathering

Researchers performed a descriptive qualitative method. Qualitative research is undertaken to comprehend and interpret occurrences in their natural context. Qualitative research aims to discover facts or an understandable comprehension of a studied topic [8].

a. Literature review

Researchers performed is a data collection process that involves collecting and analyzing information from journals, papers, books, documents, and other sources to obtain knowledge and facts to address an issue [9].

b. Interview

An interview is obtaining information through communication by posing questions and receiving responses from a resource. Researchers performed In-depth interviews are conducted to collect information about an issue under study or verify previously obtained [10].

2.1. Development Method

This research utilized the Software Development Life Cycle (SDLC) model with a prototyping approach as a cycle for system planning, development, and maintenance. In the SDLC model, prototyping involves constructing a system prototype before its development. This process allows the user to submit feedback on the prototype, and development commences once the prototype has been authorized. In this study, the prototyping procedure consisted of the following steps.

a. System Needs Analysis

System needs were determined and assessed by reviewing relevant publications and journals and interviewing resource persons. This phase defined which supporting software would be utilized throughout development.

b. Prototype Building

A prototype was built using the data gathered in the previous phase.

c. Prototype Evaluation

The user assessed the prototype and gave feedback. Improvements were made to the prototype to fulfill user needs.

d. System Implementation and Testing

The prototype was implemented through system development and testing.

e. System Evaluation

The user examined the completed system; once the user accepted the system, it was put into operation.

f. System Usage

After the implementation phase, system testing, and user approval, the user could utilize the system.

3. Results

3.1 Results and Discussion

Black-Box Testing

Black-box testing validated the results of the system's process. Table 1 displays the testing results.

Table 1. Administrator Login Testing

Testing	Expected Results	Results Obtained	Status
Opening the application without login into the account	Displaying the login page	The application displayed the login page.	Succeed
The administrator authenticates with email and password when logging in.	Moving to the monitoring list page	The login process was successful, and the application moved to the monitoring list page.	Succeed
The administrator enters the wrong email and password when logging in.	Displaying an error message snackbar	The login process was unsuccessful, and the application displayed a snackbar of incorrectly entered credentials.	Succeed

Table 2 Administrator Monitoring List Testing

Testing	Expected Results	Results Obtained	Status
Opening the application with a logged-in account	The application can display the monitoring list.	After the login process or the administrator logged in, the application displayed the monitoring list.	Succeed
The administrator clicks the monitoring data in the monitoring list.	The application can display the data change page.	The application moved to the data change page with the form filled in with the selected monitoring data.	Succeed
The administrator clicks the plus icon on the monitoring list page.	The application can display the add data page.	The application moved to the add data page.	Succeed
The administrator clicks the list icon and the monitoring map button.	The application can display the monitoring map page.	The application moved to the monitoring map page.	Succeed

Table 3 Administrator Monitoring Map Testing

Testing	Expected Results	Results Obtained	Status
The administrator clicks the marker contained in the map.	The application can display monitoring point information on the map.	The application displayed monitoring point information in the form of name and altitude, location, and additional information.	Succeed
The administrator clicks the list icon and the log-out button.	The administrator can log out from the application.	The application logged out of the account and displayed the login page.	Succeed
The administrator clicks the list icon and the monitoring list button.	The application can display the monitoring list page.	The application moved to the monitoring list page.	Succeed

Table 4 Add Administrator Data Testing

Testing	Expected Results	Results Obtained	Status
The administrator clicks the add monitoring data button without filling out all or some forms.	The application displays an error message displayed on the form.	The application displayed an error message on an unfilled form.	Succeed
The administrator clicks the maps icon, selects a location on the map on the page, selects coordinates, and clicks the check icon.	The coordinate form can be filled in from the output page fetching the coordinates.	After the administrator took the coordinates, the coordinates form in the added data view was filled.	Succeed
The administrator fills out the form and clicks the add monitoring data button.	Monitoring data can be added.	The monitoring data were added successfully, and the application moved to the monitoring list page.	Succeed

Table 5 Testing of Administrator Data Changes

Testing	Expected Results	Results Obtained	Status
The administrator clicks the change monitoring data button without changing the form.	The process of changing monitoring data can be carried out.	The monitoring data change process was successful, and the application moved to the monitoring list page.	Succeed
The administrator clicks the clear monitoring data button and the clear button.	Monitoring data are deleted.	The deletion of monitoring data was successful, and the application moved to the monitoring list page.	Succeed
The administrator clicks the change monitoring data button by filling in invalid data.	The application displays an error message.	The application displayed an error message on the form.	Succeed

Table 6 User Monitoring Map Testing

Testing	Expected Results	Results Obtained	Status
Opening the application	Displaying the monitoring map page	The application displayed a monitoring map containing information on monitoring points in the form of markers.	Succeed
The user clicks the location icon and grants the permissions the application needs.	Displaying the device location	The application displayed the location of the device on the map.	Succeed
The user clicks the marker on the map.	Displaying monitoring point details	The application displayed a modal bottom view containing the monitoring points' names, locations, elevations, and coordinates.	Succeed
The user clicks the information icon.	Displaying the number of monitoring points	The application displayed a modal bottom containing the number of monitoring points with categories based on height.	Succeed

White-Box Testing

White-box testing tested the functions of the system. In this study, white-box testing employed a basic path-testing technique. It tested the logical flow of a function by describing a flowgraph of the logical path and creating test cases for each logical path. The stages of white box testing are as follows.

a. Analyzing the functions of the system and changing them in the form of a flowchart
b. Creating a flowgraph based on the flowchart created
c. Obtaining the number of independent paths by calculating cyclometric complexity based on the flowgraph created
d. Testing each logical path in the functions by creating test cases based on independent paths

The outcomes of white-box testing in this investigation are as follows.

Login Testing – Administrator

Login is a process in the administrator application to gain access to the application. This testing was performed before the administrator obtained access to the application. Figures 1 and 2 display flowchart and flowgraph diagrams.

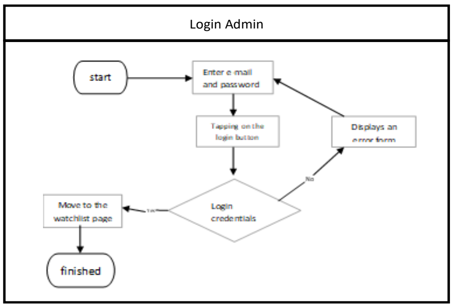

Login Admin
start
Enter e-mail and password
Tapping on the login button
Displays an error form
No
Login credentials
Yes
Move to the watchlist page
finished

Figure 1 Login Flowchart – Administrator

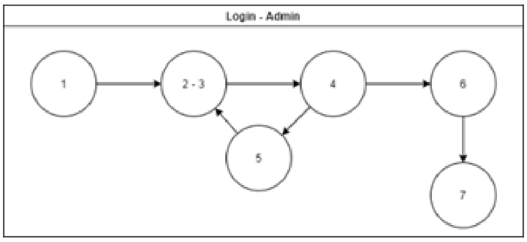


Figure 2 Login Flowgraph – Administrator

The calculation of cyclometric complexity in the login testing was carried out following the flowgraph in Figure 2. The flowgraph in the login testing had six edges, and the calculation of cyclometric complexity was performed with the following formula.

V(G) = 6 edges - 6 nodes + 2 = 2

The cyclomatic complexity calculation from the login flowgraph acquired a value of 2, with independent paths as follows.

Path 1: 1-2-3-4-6-7
Path 2: 1-2-3-4-5-2-3-4-6-7

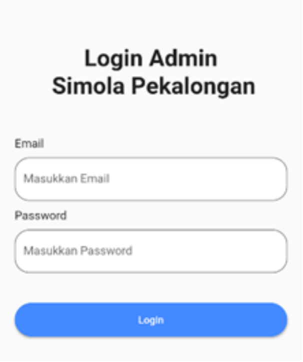
Test cases were executed to verify that the results of the functions matched the expected outcomes. The test case on the login testing is displayed in Table 7.

Tabel 7 Login Testing

No.	Process Path	Scenario	Result
1	1-2-3-4-6-7	The administrator inputs a valid email address and password and clicks the login button. The login authentication procedure is successful, and the monitoring list page is displayed.	Succeed
2	1-2-3-4-5-2-3-4-6-7	The administrator types an invalid email address and password and clicks the login button. The login authentication fails, and an error message is displayed. The administrator re-enters the proper email address and password, then clicks the login button. When login authentication is successful, the monitoring list page is displayed.	Succeed

Display Implementation

Administrator Application



Login Admin
Simola Pekalongan

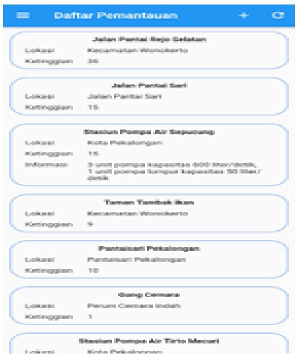
Email

Masukkan Email

Password

Masukkan Password

Login



Daftar Pemantauan + ⟳

Jalan Pantai Rejo Selatan
Lokasi Kecamatan Wonokerto
Ketinggian 36

Jalan Pantai Sari
Lokasi Jalan Pantai Sari
Ketinggian 15

Stasiun Pompa Air Sepucung
Lokasi Kota Pekalongan
Ketinggian 15
Informasi 3 unit pompa kapasitas 600 liter/detik, 1 unit pompa lumpur kapasitas 50 liter/detik

Taman Tambak Ikan
Lokasi Kecamatan Wonokerto
Ketinggian 9

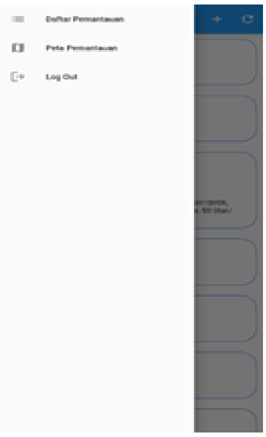
Pantaisari Pekalongan
Lokasi Pantaisari Pekalongan
Ketinggian 10

Gang Cemara
Lokasi Perum Cemara Indah
Ketinggian 1

Stasiun Pompa Air Tirto Mecari
Lokasi Kota Pekalongan

Figure 3 Administrator Login Figure 4 Administrator Monitoring Lis

Figure 3 depicts the login screen where an administrator could input an email address and password before clicking the login button to authenticate. The application displayed an error snackbar when the supplied email address or password was invalid. The administrator could access the application when the credentials supplied were valid. Figure 4 illustrates the implementation of a monitoring list page covering information about monitoring sites, such as names, positions, heights, and other details. This page had several buttons, such as the refresh icon, reloading the monitoring list; the + icon, displaying the additional data page; and the list icon, displaying the sidebar page. The data change page was accessible by clicking one of the items in the monitoring list.



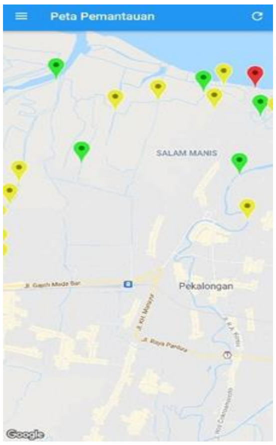
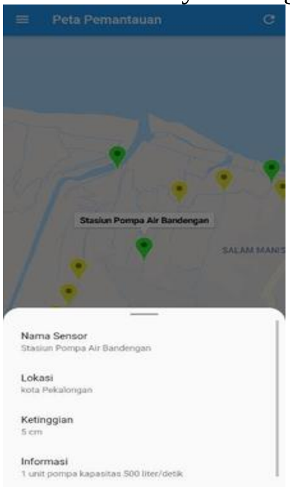


Figure 5 Administrator Sidebar Figure 6 Administrator Monitoring Map

Figure 5 exhibits the sidebar view that could be reached through the monitoring list page or the monitoring map page. The sidebar display had various buttons, including the monitoring map button, used to get to the monitoring map page, and the log out button, used for logging out of the administrator account and navigating to the monitoring login page. The Sidebar view could be closed by swiping left or touching the view on the right. Figure 6 portrays the monitoring map implementation. The monitoring map page displayed a Wonokerto Village map. The monitoring point data depicted by the marker indicates the presence of a puddle in Wonokerto Village. This page had many buttons, including one to reload monitoring data and another to display the sidebar page. As seen in Figure 9, monitoring point information such as name, altitude, position, and further information could be accessed by clicking the marker on the map.



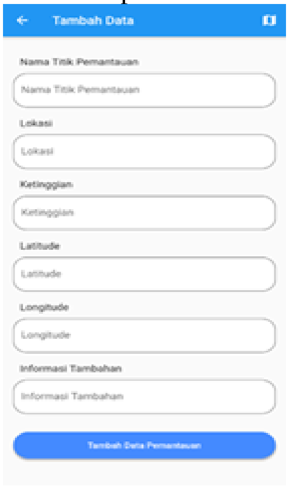
Nama Sensor
Stasiun Pompa Air Bandengan

Lokasi
kota Pekalongan

Ketinggian
5 cm

Informasi
1 unit pompa kapasitas 500 liter/detik

Figure 7 Details of Administrator Monitoring Points



Nama Titik Pemantauan
Nama Titik Pemantauan

Lokasi
Lokasi

Ketinggian
Ketinggian

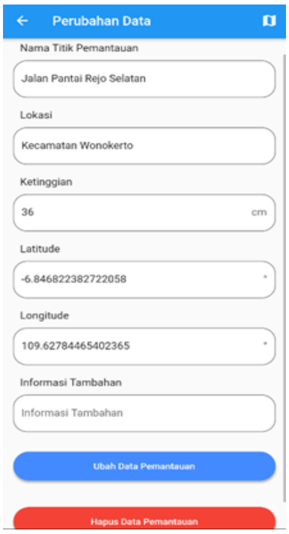
Latitude
Latitude

Longitude
Longitude

Informasi Tambahan
Informasi Tambahan

Figure 8 Add Administrator

Figure 8 illustrates the implementation of the page used to add monitoring points. This page provided names, locations, altitudes, latitudes, and longitudes, as well as other details. This view also contained a map icon displaying a page for retrieving coordinates when clicked. After completing the form and selecting the add monitoring data button, the process of adding data was initiated. After a successful run, the application displayed a monitoring list page, and when an error occurred, it demonstrated an error snackbar.



Nama Titik Pemantauan
Jalan Pantai Rejo Selatan

Lokasi
Kecamatan Wonokerto

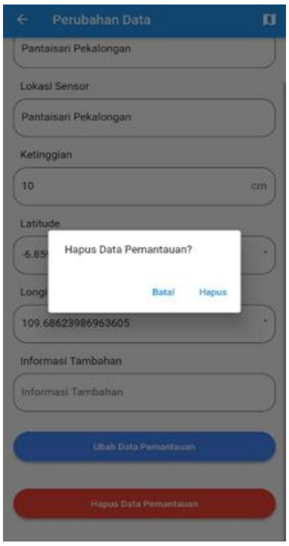
Ketinggian
36 cm

Latitude
-6.846822382722058 °

Longitude
109.62784465402365 °

Informasi Tambahan
Informasi Tambahan

Figure 9 Administrator Data Changes



Pantaisari Pekalongan

Lokasi Sensor
Pantaisari Pekalongan

Ketinggian
10 cm

Latitude
-6.85

Hapus Data Pemantauan?

Longi

109.68623986963605 °

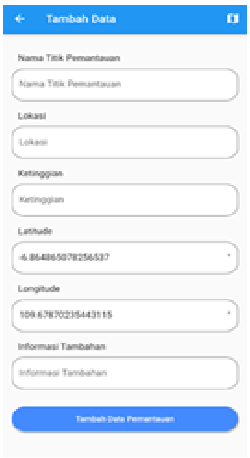
Informasi Tambahan
Informasi Tambahan

Figure 10 Clear Administrator Monitoring Data Dialog

Figure 9 depicts a data change page implementation used to modify monitoring point data. Similar to the add data page, this page provided forms for name, location, altitude, latitude, longitude, and additional information. This form offered information about the monitoring locations specified on the monitoring list page. This view also contained a map icon presenting a page for retrieving coordinates when clicked.

After filling out the form and clicking the change monitoring data button, the monitoring data could be modified. In addition, monitoring data could be removed by pressing the clear monitoring data button, depicting a confirmation box, as seen in Figure

10. After a successful run, the application displayed a monitoring list page and an error snackbar when there was an error with the change or deletion process.



Tambah Data

Nama Titik Pemantauan: Nama Titik Pemantauan

Lokasi: Lokasi

Ketinggian: Ketinggian

Latitude: -6.864865078256537

Longitude: 109.67870235443115

Informasi Tambahan: Informasi Tambahan

Figure 11 Taking Administrator Coordinates

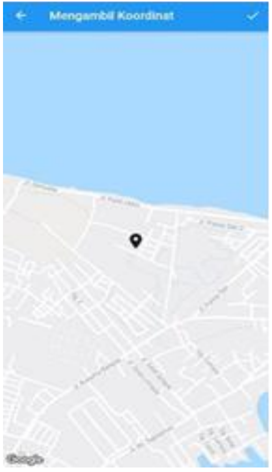


Figure 12 Results of Taking Administrator Monitoring Coordinates

Figure 11 denotes the page implementation of taking the coordinates on the map to facilitate adding or modifying monitoring data. This page displayed a map with the specified coordinates indicated by a marker icon in the middle. The coordinates could be determined by swiping and pinching to select a spot on the map and touching the check symbol. As illustrated in Figure 12, the results of selecting coordinates were recorded in decimal numbers.

User Application

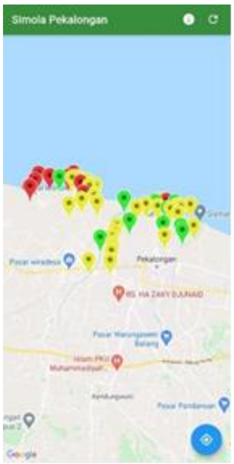
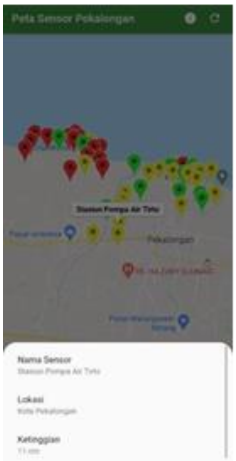


Figure 13 User Monitoring Map

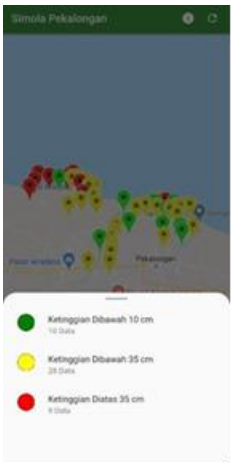


Nama Sensor
Stasiun Pompa Air Tirto

Lokasi
Kota Pekalongan

Ketinggian
11 cm

Figure 14 Details of User Monitoring Points



● Ketinggian Dibawah 10 cm
10 Data

● Ketinggian Dibawah 35 cm
28 Data

● Ketinggian Diatas 35 cm
9 Data

Figure 15 Number of User Monitoring Points

Figure 13 depicts the user interface for the monitoring map page. This page provided a map with marker icons representing monitoring sites. This page included a refresh icon for reloading monitoring data, a location icon for displaying the device's position on the map, and an info icon for displaying the number of monitoring points. The device's location was presented after requesting the user's permission to view its location. It could be displayed if the user granted the application access to the device location. A detailed view of monitoring points could be obtained by clicking the map marker. Figure 14 demonstrates the monitoring point detail view that could be accessed from the monitoring map page. This view was used to display the selected monitoring point's details. This page's information included the place's name, location, and altitude. Figure 15 represents the number of monitoring points viewed by touching the info button on the monitoring map page. This view displayed the number of monitoring points on the map. The displayed information was the number of monitoring stations classified by height.

4. Conclusion

The following conclusions were drawn from the design results and the development of the simulation of the water level monitoring system in Pekalongan City. Water level monitoring system simulation in Pekalongan City generated two applications, one for the administrator and the other for users. Using the simulation application, the administrator could view, upload, modify, delete monitoring data, and observe monitoring locations displayed on the map. In addition, the user could observe the distribution of monitoring points on the map, and display monitoring point data, the number of monitoring points, and the device's position. The construction of a water level monitoring simulation in Pekalongan City could be a starting point for developing a water level monitoring system to assist the residents with transportation issues during floods.

References

[1] Cahyadi, A., Marfai, M. A., Mardiatno, D., and Nucifera, F. (2017) "Spatial Modeling of Rob Flood Hazards Based on Climate Change Scenarios and Their Impacts on Pekalongan Coastal Areas." [online] (In Indonesia) https://osf.io/preprints/inarxiv/wzter/ [23 August 2021].

[2] Sauda, R. H., Nugraha, A. L., and Hani'ah, H. (2019) "Study of Rob Flood Vulnerability Mapping in Pekalongan Regency." (In Indonesia) Jurnal Geodesi Undip, 8(1), Hal 466–474.

[3] M Idhom, A. (2021) "Pekalongan Flood February 2021 More than 1 Week, Refugees Still 1500." (In Indonesia) tirto.id. [online] https://tirto.id/banjir-pekalongan-februari- 2021-lebih-1-pekan-pengungsi-masih-1500-gaiX [19 May 2021].

[4] Bernardi, R. (2021) "Floods hit Pekalongan City again, submerged 16 sub-districts." detiknews. (In Indonesia) [online] https://news.detik.com/berita-jawa- tengah/d-5361327/banjir-kembali-landa-kota-pekalongan-16-kelurahan- terendam [19 May 2021].

[5] Marfai, M. A., Cahyadi, A., Kasbullah, A. A., Hudaya, L. A., and Tarigan, D. R. (2017) "The Impact of Coastal Floods and Community Adaptation to Them in Pekalongan Regency." [online] (In Indonesia)https://osf.io/preprints/inarxiv/m273k/ [7 September 2021].

[6] Mertha, I. M. P., Simadiputra, V., Setyawan, E., and Suharjito, S. (2019) "WebGIS Implementation for Mapping West Jakarta City Tourism Objects with the Location Based Service Method using the Google Maps API." (In Indonesia) InfoTekJar : Jurnal Nasional Informatika dan Teknologi Jaringan, 4(1), Hal21–28.

[7] Lukman, M., Bagye, W., Fahmi, H., and Imtihan, K. (2019) "Utilization of Google Maps Api Technology for Android-Based Crime-Prone Location Detection Application Case Study: Chang Village and Mujur Village, East Praya District, Central Lombok Regency." (In Indonesia) Jurnal Informatikadan Rekayasa Elektronik, 2(1), Hal 52–59.

[8] Chariri, A. (2009) "Philosophical Foundations and Qualitative Research Methods." (In Indonesia) [online] http://eprints.undip.ac.id/577/ [19 August 2021].

[9] Mirzaqon, A. (2018) "Literature Study Concerning the Theory and Practice of Expressive Writing Counseling." (In Indonesia) Jurnal BK UNESA, 8(1). [online] https://jurnalmahasiswa.unesa.ac.id/index.php/jurnal-bk- unesa/article/view/22037 [27 August 2021].

[10] Rahardjo, M. (2011) "Qualitative research data collection methods." [online] http://repository.uin-malang.ac.id/1123/ (In Indonesia) [22 August 2021].