SOCIUS:
Jurnal Pendidikan dan Pembelajaran Ilmu Pengetahuan Sosial
Volume 11, No 2, Oktober 2022, pp. 31-42
P-ISSN: 2089-9661 | E-ISSN: 2089-967X
DOI:*10.20527/js.v11i2.14576*
Open Access: https://ppjp.ulm.ac.id/journal/index.php/JS/index

PREDICTION, MONITORING, AND EARLY WARNING SYSTEM OF WATER LEVELS IN FLOOD PROGRAM AREAS IN BANJARMASIN USING IoT AND LINEAR REGRESSION

Muhammad Akbar Wicaksana[1] Hilal Hudan Nuha[2]

[1] *Telkom University, Indonesia.*
[2] *Telkom University, Indonesia*

A R T I C L E I N F O

Article history:
Received 22 Agustus 2020
Accepted 18 September 2022
Available online 15 Oktober 2022

Kata Kunci:
peringatan dini; regresi linier sederhana; IoT;Kota Banjarmasn

Keywords:
early warning; simple linear regression; IoT; Banjarmasin City

A B S T R A C T

Banjarmasin is a city of a thousand rivers, floods often occur due to high tides and high rainfall. An early warning system is needed for monitoring and predicting river tides, especially in rivers that are prone to disasters. This study aims to develop an early warning system for river water levels using IoT and predictions with linear regression analysis. The research method in the early stages is the manufacture of an early warning system device with NodeMCU V3, Microcontroller, and ultrasonic sensors A02YYUW. Monitoring to collect water level data at high tide through the LCD based on ultrasonic sensors on the banks of the river and sent to the Mysql database, predictions using simple linear regression analysis. The results showed that the early warning system was affected by rising river water levels. Simple regression analysis showed significant results on the t-test and simple linear regression equation $\hat{Y}$= 29.472 - 0.061 X + e. This means that the river water level at high tide approaches an early warning tool, namely an ultrasonic sensor. The conclusion of this study is that the results of an IoT-based early warning system analyzed by simple linear regression can be used to monitor and predict river water level rise.

Corresponding author.
E-mail addresses: akbarerdogan55@gmail.com

INTRODUCTION

Flood disasters often occur suddenly, especially in riverbank areas. In 2021 the city of Banjarmasin was hit by a large flood, causing casualties and property. This flood occurs because of high tides in low-lying areas, especially on the banks of the Barito and Martapura rivers, as well as several of their tributaries (Antara, 2022). This flood occurs throughout the year from January 2021 to December 2021. The cause of the flood is due to high tides accompanied by high rainfall, so that the overflowing river cannot accommodate water (Hidayatullah, 2021; Ridwan et al., 2022).

The city of Banjarmasin is an area with conditions that are often inundated by water, puddles of water are often seen on the streets of villages and highways. This is caused by the tide of the river that surrounds the city. The estuary of this river is the Java Sea, the ebb and flow of river water is a condition of rising and falling sea levels. Tides are caused by the attraction of the moon and sun to the earth. When the full moon or the beginning of the moon the highest tide occurs because the attraction of the moon/sun to the earth reaches its maximum point, in contrast to when the crescent moon occurs only small tides, because the attraction of the moon is at its lowest point. (Anwar & Mawardi, 2021).

Flood events can be avoided by early prevention, one of which is the manufacture of early warning tools. Monitoring of the river water level is expected to be carried out through an early warning system tool, then prediction with linear regression analysis so that it can predict the occurrence of flood hazards.

Early warning system tools for monitoring and predicting river water level rise have been developed in the form Internet of things (IoT) (Valentin, 2021; Sutarti et al., 2022). IoT is internet connectivity that is always connected at all times on a network, so that information about physical objects can be seen, heard, as data from ultrasonic sensor. IoT as a flood early warning system functions as a water level detection system at all times. IoT production is more economical and safe, as it utilizes microcontroller-based ultrasonic sensors. The increase in river water level can be informed quickly to the community accompanied by an alarm sound (Windiastik et al., 2019).

Research on IoT as an early warning system and monitoring of rising river water levels has been carried out, indicators of research findings indicate that water level rise can be predicted and monitored using IoT, the information resulting from ultrasonic sensor forwarded to the website and LCD in real time, water rises can continue followed until it reaches a critical level (Wicaksono et al., 2021; Baskoro et al., 2021).

IoT for early warning of river water level rise is a simple and inexpensive system that can be used by many people on the banks of the river in Banjarmasin City. Riverside communities (Putro, Jumriani, et al., 2020) The city of Banjarmasin also has access to traditional information management, in the form of loudspeakers located at the top of each Mosque. Access to information in the Mosque can be used to transmit river water level information to the public on the website and sound alarms. In addition to that several works under IoT topic have been reported for clay plant grafting monitoring (Nurhalim & Nuha, 2022), hydroponics (Banjarsari et al., 2022), and footstep recognition (Nugraha & Nuha, 2022).

The problem of this research is to determine the effect of surface elevation on each time change based on the results of monitoring with ToT, and to determine the prediction of river water level rise generated by IoT with linear regression. The variables studied were time as variable X (dependent variable) and river water level as variable Y (independent variable). The research hypotheses are: There is no effect between river water level on an IoT-based early warning system (Ho), and there is an effect between river water level on an IoT-based early warning system (Ha).

LITERATURE REVIEW

Banjarmasin is known as the city of a thousand rivers, known for its river culture. The city of Banjarmasin is surrounded by rivers, the major rivers in Banjarmasin are the Barito River and the Martapura River with branches flowing everywhere. The condition of the city of Banjarmasin is often flooded. This is due to the ebb and flow of overflowing river water. The estuary of the river is the Java Sea, the ebb and flow of river water as a condition of rising and falling sea levels. Sea tides are caused by the attraction of the moon and sun to the earth (Anwar & Mawardi, 2021). In addition, geographically the position of the city of Banjarmasin is 0.16 m below sea level, the tides of the river occur all the time as a result of the "hydrodynamic" of the Barito river whose estuary is in the Java Sea (Kusliansjah, 2012).

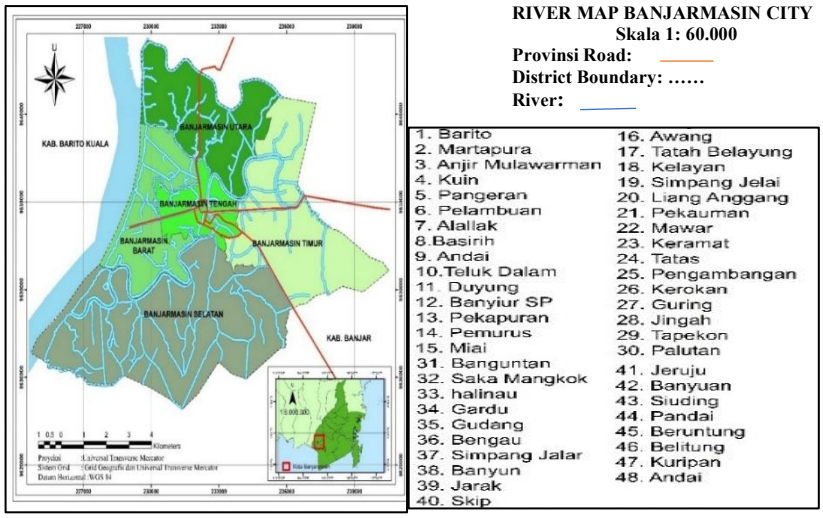


Figure 1: River Map in Banjarmasin (Putro, Arisanty, et al., 2020).

Disasters can occur when high tides exceed the maximum accompanied by heavy and prolonged rainfall, as happened in January 2021. High tides accompanied by continuous rains have caused most areas to be inundated with water sent from other areas due to the position of Banjarmasin City downstream. Martapura River (Flood in Banjarmasin is getting higher, residents are starting to evacuate, tt).

IoT (Internet of Things*)* is the use of the internet that is connected all the time. Through IoT, physical activity and various information about an event can be known. Physical activity and information can be known because of the sensor. The sensor is an ultrasonic sensor to capture critical events, as input the sensor can forward a signal in the form of information or an alarm when there is a critical condition. IoT technology can connect certain equipment with the use of the internet to carry out certain activities or various functions. The process of implementing an IoT device can save power and be wireless (Danang et al., 2019).

IoT to provide information on flood disaster events is used to read data from ultrasonic sensors placed on the banks of rivers, ultrasonic sensors will forward water level data continuously, so that monitoring and prediction of water levels can be carried out at any time (Ibrahim, 2018).

NodeMCU V3

NodeMCU V3 ESP8266 is a microcontroller, also called Arduino, equipped with an ESP8266 WiFi module. In addition there is a memory for storing programs, there port digital input-output, an analog input and a port with special functions such as serial UART, SPI, I2C etc. (ardutech, 2020). Arduino UNO is an Atmega328 microcontroller. The microcontroller

will read the sensor, in this study it is a type of river water level sensor, then the sensor data is sent by the microcontroller to the computer to be processed and analyzed (Pambudi, WS, 2021: 11).

Microcontroller

Microcontroller is a chip or IC (Integrated Circuit) that receives input signals, then processes and conveys signals as output according to the program on a system (Valentin, 2021), microcontroller contains a microprocessor, memory, input/output (I/O) lines and other complementary devices. Arduino UNO is the minimum ATmega328 microcontroller system (Pambudi, WS, 2021: 65).

Ultrasonic sensors are used as input for detection devices. For actuators in the form of a relay module as a circuit breaker and buzzer and indicator lights. In this flood detection system, the devices used are NodeMCU V3, buzzer sensor ultrasonic as a detection system and information system. This system can quickly detect water and issue warnings. This research was developed in the form of an IoT useful for the community to get information about water levels faster that can cause flooding (Windiastik et al., 2019).

Ultrasonic A02YYUW

Ultrasonic sensor, a tool for measuring the distance of an object. Specifications A02YYUW ultrasonic is waterproof with an effective distance of 4.5 m, works according to Arduino with 3.3V or 5V devices. A02YYUW is able to process signals, to determine the distance of an object. The ultrasonic sensor works based on the reflection of sound waves with a certain frequency to determine the distance of an object, the sensor continues the received sound waves with the time difference between the sound waves emitted and received, based on a straight comparison with the reflection of the distance or height of the object in the form of a solid or liquid substance. Ultrasonic sensors can be easily connected to the microcontroller. (A02YYUW Waterproof Ultrasonic Sensor Wiki - DFRobot, tt). Furthermore, the ultrasonic sensor data base A02YYUW is sent to the Mysql database.

Management system database for storing and managing information needed on websites. MYSQL is a software that functions to manage information on a database *server* with the SQL programming language. MYSQL is “open source” meaning that the application can be modified freely, can be changed as needed management system database is: (1) compiling the database, storing, modifying data and determining the relationship between the tables in it, (2) client provides special instructions using the SQL programming language, (3) then server distributes the commands received and display information on the client (Yonata, 2021).

Linear regression is a statistical method used to form a model of the relationship between variables (Sujarweni, VW, 2015). Regression analysis is at least useful, for the purpose of description of the data phenomenon or case being studied, for control purposes, as well as for prediction purposes. Linear regression is able to describe data phenomena through the formation of a numerical relationship model. Linear regression can also be used to control or control a case or things that are being observed with the obtained regression model. Regression can also be used to make predictions on the dependent variable.

RESEARCH METHODS

Flowchart Research on monitoring and predicting water levels in disaster-prone areas using the Internet of Things (IoT) and linear regression begins with a field study to determine the tides of river water, community habits and the determination of models of system early warning and Journal of relevant research on systems flood early warning with IoT.

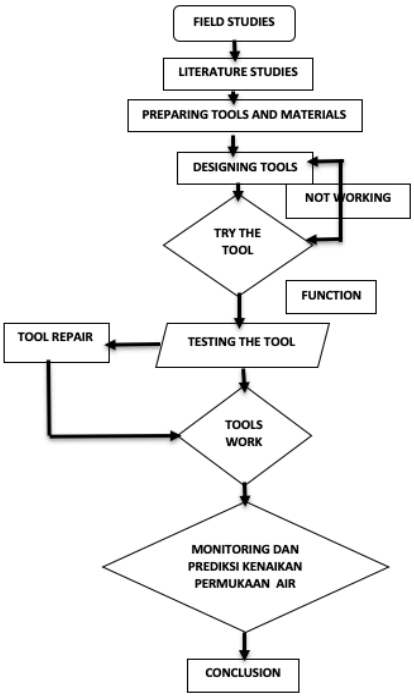


Figure 2: Flowchart Research

Further identification of the materials needed, integrated and tested, if in the trial the tool does not function, feed back on the design of the tool, if the tool is functioning, a design test is carried out at the location of the river bank, namely the Awang River, a branch of the River Martapura, if the test is not successful, an evaluation is carried out to find the cause, if the test is successful or the tool is functioning, monitoring and prediction of water level movements are carried out and analyzed using Regression, finally drawing conclusions.

Data Collection

A02YYUW ultrasonic sensor results data on MYSQL database, formatted in Excel. The buzzer blames the alarm when the water level approaches the sensor ≤ 15 cm, the table in the MYSQL database will inform you in the form of the words "Early Warning". If the sensor distance to the water surface is > 15 cm, the MYSQL database will inform you that the words "Install" means that the river water is starting to rise.

Data collection was carried out on September 6, 2022 at 22.00 (Central Indonesia Time) to September 7, 2022 at 03.00 (Central Indonesia Time). The level of increase in water level is obtained based on the location of the tool with the river water level, the level of increase is calculated every minute, which means 300 minutes. Monitoring time for predictions is carried out at night, because it is based on information from riverside communities that the peak of the tide will occur at around 02.00 in the morning.

Data Analysis

Monitoring data is then analyzed with Simple Linear Regression, to predict monitoring data, namely early warning information due to rising tide levels. Data analysis was carried out using SPSS 26.

The time from high tide to early warning was about 300 minutes as the X variable while the distance of the water level rise with the tool as the Y variable.

RESEARCH RESULTS AND DISCUSSION

Early warning tool for prediction and monitoring of river water level with ToT that has been developed are as follows:

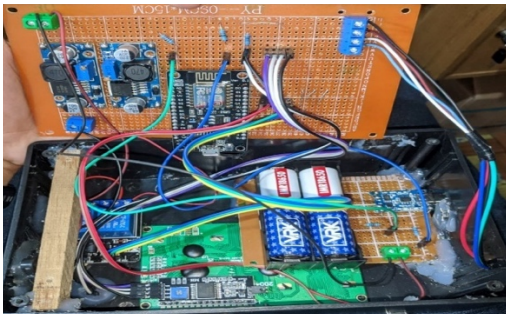


Figure 3: A series of early warning tools for monitoring water levels.

The working system of the tool that has been developed is described in the system as follows:

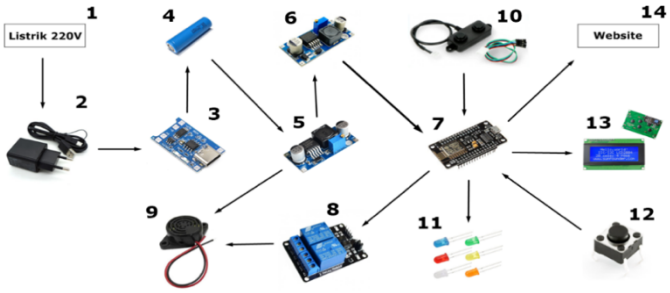


Figure 4: Equipment Design

Description:

1. AC 220V electricity
2. *Adapter* 5V
3. TP4056 + *Protect*
4. Li Battery -Ion
5. XL6009 (*Step-Up*)
6. LM2596 (*Step-Down*)
7. NodeMCU V3
8. Relay (Optocoupler)
9. Buzzer 12V
10. *Ultrasonic* A02YYUW
11. LED 5mm
12. Push Button
13. LCD 20X4
14. *Website*

The working system of monitoring and predicting early warning of water level with the IoT uses a 220V AC power source which is routed to a 5V adapter to supply the TP4056 module to charge the Li-Ion 18650 battery, because the 18650 battery only has a voltage of 3.7V, a step-up to increase the voltage from the battery to 12V in order to supply the 12V Buzzer and also be forwarded to the step-down to reduce the voltage to 5V in order to supply the NodeMCU. After the microcontroller gets a sufficient supply, the device will immediately activate and work. NodeMCU V3 functions to read the ultrasonic sensor, control the LED lights, and buttons. Then the ultrasonic sensor A02YYUW is sent to the MYSQL database. Then website displays data from the MYSQL database so that users can view the data in tabular form and can also export it into Excel form.

Ultrasonic sensor A02YYUW on a tool for early warning prediction and monitoring of river water levels is placed on the bank of the Awang River in Banjarmasin, a branch of the Martapura River.

Figure 5: Location of the tool during testing

Ultrasonic sensor A02YYUW is placed on the surface of the river water, the 12 V early warning alarm or buzzer is designed to sound if the sensor distance from the river water surface is getting closer to 15 cm. The water level rise in the form of a graph table on the MYSQL database can be monitored via the LCD in the house.

The frequency of water level distance with flood early warning tools is carried out for 300 minutes, on September 6, 2022 at 22.00 (Central Indonesia Time) a until September 7, 2022 at 03.00 (Central Indonesia Time), the following table shows a summary of the increase in river water level:

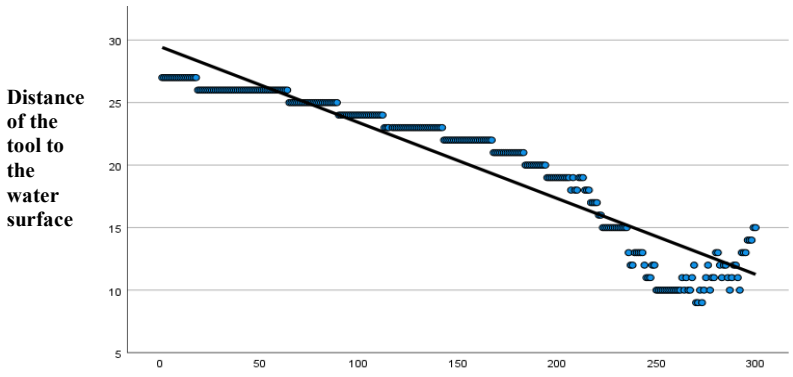
Table 1: Monitoring Results

Date	and Time (WITA)	Distance from River Water Surface to Equipment (cm)	Frequency	Status
6 September 2022	22.00 – 23.29	25 - 27	89	pairs
	23.30 – 24.47	22 - 24	78	pairs
7 September 2022	24.48 – 01.26	19 - 21	43	pairs
	01.27 – 01.42	16 - 18	12	pairs
	01.43 – 02.03	13 - 15	29	early warning
	02.04 – 02.20	10 - 12	46	early warning
	02.28 – 02.31	7 - 9	3	early warning

Ultrasonic sensor A02YYUW is placed on the surface of the river water, the 12 V early warning alarm or buzzer is designed to sound if the sensor distance from the river water surface is getting closer to 15 cm. The water level rise in the form of a graph table on the MYSQL database can be monitored via the LCD in the house.

The frequency of water level distance with flood early warning tools is carried out for 300 minutes, on September 6, 2022 at 22.00 (Central Indonesia Time) a until September 7, 2022 at 03.00 (Central Indonesia Time), the following table shows a summary of the increase in river water level:

Graph 1: Regression Linearity



Analysis of simple linear regression data obtained a correlation coefficient value of 0.94 meaning that the linear relationship between high tide time and river water level rise is very

strong. The coefficient of determination *R Square* is 0.891, meaning that the effect of high tide time on water level rise is 0.891 or 89.1%, the remaining 10.9% is influenced by other variables. This shows that early warning on river water levels can be predicted using IoT and linear regression analysis.

Table 2: Results of R Square

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.944[a]	.892 .891	1.838	a

. Predictors: (Constant), minute

b. Dependent Variable: tool-water distance

Prediction can also be seen from the results of the t test with linear regression analysis which shows a "t" significance value of 0.000 < compared to the "p" value (0.05) so it can be predicted that the tide time has a significant effect on water level rise. river. When the water river starts from high tide until high tide affects the height of the river level, so that the distance of the river water level approaches the sensor.

Tabel 3. Analisis uji-t

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	29.472	.213		138.542	.000
	menit	-.061	.001	-.944	-49.546	.000

a. Dependent Variable: jarak alat-air

Prediction of early warning with IoT and linear regression can be seen from the regression coefficient a value of t count (138.542) > t table (1.960), so the regression coefficient a is significant, meaning this tool can predict early warning on river water levels. Coefficient regression b value of t count (49.546) > t table (1.960) shows that early warning tools with IoT and linear regression analysis can predict river water level rise. Prediction of early warning can be seen from the results of F count (2454,796)>F table 3.872853), means that early warning due to rising river water levels can be predicted using IoT early warning tools and regression analysis.

Table 4: Linearity Test F

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8290.564	1	8290.564	2454.796	.000[b]
	Residual	1006.433	298	3.377		
	Total	9296.997	299			

a. Dependent Variable: jarak alat-air

b. Predictors: (Constant), menit

The regression equation $\hat{Y} = a + bx + e$ results showed $\hat{Y} = 29.472 - 0.061\ x + e$. This means that the river water level at high tide will approach the early warning device, namely the ultrasonic sensor

CONCLUSION

Early warning of flooding in flood-prone areas on the banks of the Banjarmasin river can be monitored and predicted using the IoT with early warning system and regression analysis. Ultrasonic sensors on tools installed on river banks have been able to capture rising tides.

The regression analysis used is simple linear regression analysis, the prediction of the results of monitoring the early warning system tool with simple linear regression has received and shows significant t, R, and simple linear regression equations..

DAFTAR PUSTAKA

A02yyuw Waterproof Ultrasonic Sensor Wiki—Dfrobot. (T.T.). Diambil 9 Oktober 2022, Https://Wiki.Dfrobot.Com/_A02yyuw_Waterproof_Ultrasonic_Sensor_Sku_Sen0311

Anwar, K., & Mawardi. (2021). *Hidrologi*. Http://Repository. Pertanian.Go.Id/Handle/123456789/14857

Ardutech. (2020, Februari 22). Apa Itu Nodemcu V3 & Fungsinya Dalam Iot (Internet of Things). *Ardutech*. Https://Www.Ardutech.Com/Apa-Itu-Nodemcu-V3-Fungsinya-Dalam-Iot-Internet-Of-Things/

Banjir Di Banjarmasin Makin Tinggi, Warga Mulai Mengungsi. (T.T.). Diambil 22 Juni 2022, Https://Kalsel.Inews.Id/Berita/Banjir-Di-Banjarmasin-Makin-Tinggi-Warga-Mulai-Mengungsi

Banjaransari, H., Nuha, H. H., & Yulianto, F. A. (2022). Perancangan Sistem Pencahayaan Otomatis Menggunakan RTC (Real Time Clock) Berbasis Arduino untuk Tanaman Hidroponik dalam Ruangan. *eProceedings of Engineering*, 9(4).

Baskoro, F., Nafik, A. S. I., Baskoro, F., Widodo, A., & Rahmadian, R. (2021). Monitoring, Bendungan, Esp8266, Rancang Bangun Prototype Monitoring Ketinggian Air Pada Bendungan Berbasis Internet of Things. *Jurnal Teknik Elektro*, *10*(1), 29–35. Https://Doi.Org/10.26740/Jte.V10n1.P29-35

Danang, D., Suwardi, S., & Hidayat, I. A. (2019). Mitigasi Bencana Banjir Dengan Sistem Informasi Monitoring Dan Peringatan Dini Bencana Menggunakan Microcontroller Arduino Berbasis Iot. *Jurnal Undip*, *40*(1), 55–60.

Hidayatullah, D. (2021). Mitos Dan Banjir. *Undas: Jurnal Hasil Penelitian Bahasa Dan Sastra*, *17*(2), Art. 2. Https://Doi.Org/10.26499/Und.V17i2.4074

Ibrahim, R. (2018). *Sistem Informasi Peringatan Dini Banjir Berbasis Internet of Things (Iot) Menggunakan Arduino* [Phd Thesis].

Kusliansjah, K. (2012). Jalan Dan Sungai, Kanal Sebagai Elemen Pembentuk Struktur Kota Sungai Banjarmasin Kalimantan Selatan. *Research Report-Engineering Science*, *1*.

Nugraha, R. A., & Nuha, H. H. (2022, June). Footstep Recognition Using Feedforward Neural Network. *In 2022 IEEE International Conference on Cybernetics and Computational Intelligence (CyberneticsCom)* (pp. 347-352). IEEE.

Nurhalim, R., & Nuha, H. H. (2022). A Literature Survey on Plant Grafting Technology and Internet of Things Solutions. *J-SAKTI (Jurnal Sains Komputer dan Informatika)*, 6(2), 686-701.

Putro, H. P. N., Arisanty, D., & Anis, M. Z. A. (2020). Learning Model of History to Wetlands For Historical Consciousness. *International Conference on Social Studies, Globalisation And Technology (Icssgt 2019)*, 67–74.

Putro, H. P. N., Jumriani, J., Darmawan, D., & Nuryatin, S. (2020). Social Life of The Community: Perspective Of Riverbanks Community In Sungai Jingah, Banjarmasin. *The Kalimantan Social Studies Journal*, *1*(2), 151–158.

Sujarweni, V. W., 2015. *SPSS untuk Penelitian*. Yogyakarta: Pustaka Baru Press.

Ridwan, A., Nuha, H. H., & Dharayani, R. (2022, July). Sentiment Analysis of Floods on Twitter Social Media Using the Naive Bayes Classifier Method with the N-Gram Feature. In 2022 *International Conference on Data Science and Its Applications (ICoDSA)* (pp. 114-118). IEEE.

Sutarti, S., Anharudin, A., & Rosadi, S. (2022). Prototype Sistem Pendeteksi Banjir Menggunakan Nodemcu Dan Protokol Mqtt Berbasis Internet of Things. *Jurnal Sistem Informasi Dan Informatika (Simika)*, *5*(1), 38–48.

Valentin, R. D. (2021). Implementasi Sensor Ultrasonik Berbasis Mikrokontroler Untuk Sistem Peringatan Dini Banjir. *Jurnal Ilmiah Mahasiswa Kendali Dan Listrik*, *2*(1), Art. 1. Https://Doi.Org/10.33365/Jimel.V2i1.1092

Wicaksono, A. M., Hasan, Y., & Rahman, A. (2021). Rancang Bangun Sistem Pendeteksi Banjir Pada Waduk Menggunakan Water Level Sensor Berbasis IoT (Internet of Things). *Teknika*, *15*(2), Art. 2.

Windiastik, S. P., Ardhana, E. N., & Triono, J. (2019). Perancangan Sistem Pendeteksi Banjir Berbasis Iot (Internet of Thing). *Seminar Nasional Sistem Informasi (Senasif)*, *3*(1), 1925–1931.

Yonata, J. (2021, Juli 10). Mysql: Penjelasan, Cara Kerja, Dan Kelebihannya. *Blog Dewaweb*. Https://Www.Dewaweb.Com/Blog/Apa-Itu-Mysql/