Research Article

Smart System for Stabilizing Water Flow Output on Android-Based Taps

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Abstract:
This study aims to produce and find out the results of the Smart System Stabilization Water Discharge Output Test on Android-Based Faucets based on the results of water flow sensor readings whose data is used as a reference for the rotation of the Adj or Adjustable Water Pressure Reducing Regulator Valve. The tests were carried out in the form of measuring water flow without and with Adj and measuring water discharge without and with Adj. Based on the research results, the water flow without Adj is 7 L/min for tap 1.9 L/min for tap 2. The water flow with Adj for both taps is 8 L/min. The flow of water from both taps is more stable with Adj than without Adj because the flow of both taps is 8 L/min. The measurement results of the water discharge without Adj are 0.1216 L/s for tap 1 and 0.1470 L/s for tap 2; the difference in water discharge is 0.0254 L/s. Water debit with Adj 0.135 L/s tap 1 and 0.14125 L/s tap 2, the difference in water discharge is 0.00625 L/s. The water debit is more stable with Adj than without Adj because the difference in water discharge is smaller.

Keywords: Smart System, Android, Discharge, Stabilization, Water

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1. INTRODUCTION

Human life is always developing and will demand a practical and efficient lifestyle. The development of this lifestyle cannot be separated from the development of increasingly modern technology, including the development of the water flow stabilization system in the pipe. Air is an essential resource to ensure economic growth [1]. A water flow on the surface is limited due to the competition of community needs [2], which is related to the increase in population and the community's economic activity in terms of number and quality. The economic development and improvement of people's living standards have increased the demand for water resources from year to year [3]. The water needs of the Indonesian people are around 125–150 liters per day per person, if calculated again around 625–1500 liters per day for family consumption levels [4], which can affect the high water needs in people's lives, namely the number of members in the house, income, and house area [5] without regard to the use of water used, causing efficiency gaps [6] so that it can have a negative impact on water resources [7] so that water resources become not optimal and stable [8].

Limited supply and considerable water needs result in a minimal water supply from the center. Water flow will decrease in the waterways, so water distribution becomes irregular, resulting in long water filling. In addition, in water lines that use pumps, there is a possibility of damage to the pipe or water pump because when the water pump works at maximum speed, but there is no water flowing, the pipe pressure will be greater, this can damage the water pump or pipe itself [9].

Previous studies conducted in 2009 by applying microcontroller technology to manual flowmeters with digital displays to make water flow and discharge measuring instruments [10] and the correlation between rainfall and water discharge [11], then in 2011 focused more on measuring water discharge which aimed to produce a water flow speed measuring instrument with an LCD display in m/sec [12], then conducted research to identify water consumption in 2012 [13], further development in 2014 by designing an Arduino Uno-based PDAM (Local water company) water usage monitoring application aimed at making it easier to monitor water discharge usage every month[14]. Then, development was carried out in 2015 by creating a digital monitoring system for the use and quality of PDAM water turbidity based on ATMega328 using water flow sensors and photodiode sensors to monitor water volume usage while detecting water turbidity[15]; further development by analyzing water flow in branched pipes (Junction) to overcome various problems related to pipe friction, pipe dimensions and elbow or branching so that the amount of water flowing out of the reservoir is in accordance with the discharge that enters the reservoir due to the branching of the pipe carried out in 2016[16].

Development again in 2017 where the system can regulate the flow rate of water, which at the same time filtrates to avoid people who consume water that is not suitable for drinking [17] as well as efforts to control corrosion in water [18]. Development in 2018 by creating a PDAM water usage monitoring system using NodeMCU based on Android is still manual, namely sending officers to customers' homes and recording them one by one [19], developed again in 2019 with research analyzing water quality [20] because Water resources have become a major problem in the development of social and economic development, so it is necessary to monitor the quality of water resources [21], water quality is influenced by many factors such as flow rate, contaminant load, transportation media, and site-specific parameters [22] as well as research that monitors Arduino-based water use which is considered to bless effective and efficient and requires a lot of energy and consumes a lot of time, the water ether used by PDAM is also still analog so that water usage data is difficult for customers to know [23]. In addition, the problem of recording errors, errors in the input process of recording results, and incomplete information contained in manual water meters make it difficult to identify when there are problems contained in the discharge of water channels or contained in the tools used; therefore another development was carried out in 2020 which made an Arduino-based monitoring system [24] and patterns of water use in households [25]. Then, IoT-based water flow measurement instruments were developed in 2021 to determine real-time water use by IoT-based users with good accuracy [26].

Some previous studies were considered inefficient because they could only monitor the discharge and flow of water without stabilizing the discharge of water coming out of the faucet; it could result in long water filling, irregular water distribution, and the possibility of damage to pumps or pipes. Research on the Smart Water Discharge Output Stabilization System on Android-based faucets aims to overcome problems related to water distribution that can be monitored remotely on the Android application. In this study, a flow control device system was designed to regulate the discharge of water coming out of the tap using an adjustable water pressure reducing regulator valve where the water discharge parameters are read using a water flow sensor, then the output signal from the sensor is transmitted to ESP 32 which functions as a data processing center of all sensors.

Water is then treated on an Adjustable water pressure-reducing regulator valve, while the working mechanism of the available Adjustable water pressure-reducing regulator valve is still manual, so in this study, an Adjustable water pressure-reducing regulator valve is needed that is controlled electrically using a DC motor, where if the water flow is small then the Adjustable water pressure reducing regulator valve It automatically adjusts and provides a larger water flow and vice versa so that the water discharge output on the tap remains stable. The flow of water that has been treated on the flow control device is then transmitted to the microcontroller to be displayed on the monitoring feature of the Android application. The features contained in the Android application on the Smart System Stabilization of Water Discharge Output on this Android-Based Tap are water flow monitoring features, water flow usage history monitoring features displayed with graphs that can be viewed per day, week, or month, and location monitoring from users that can be seen on maps. The display on this monitoring system is made on supporting software, namely Android Studio. Moreover, The Smart System Stabilization of Water Discharge Output on Android-Based Faucets is expected to help and facilitate stabilizing water discharge on taps that can be monitored remotely on Android applications, and later, this system can be a solution to improve water distribution to more efficient. Until now, it has not only been on the Android or smartphone side but development has been carried out on the approach to Artificial Intelligence (29,30).

2. METHOD

2.1 Design System

The system consists of three stages: preparation, design, and assembly. As for the preparation stage, a literature study, tools and materials collection, and supporting software installation will be used to build a Smart Water Discharge Output Stabilization System on Android-based taps. Then, at the design stage, the flow control device design, the flow chart design of the Flow application, and the design of the water stabilization device are carried out. After that, PCB printing, system and application coding, and assembly (installation) are carried out at the assembly stage.

Figure 1 shows PDAM water or other sources that fill the reservoir flowing through the pump and then detect the amount of water discharge using a water flow sensor; then, the output signal from the sensor is transmitted to ESP32, which functions as a data processing center of all sensors. The sensor readings are used as a reference for rotation of the motor, where if the sensor reads the water flow smaller than the predetermined stable value, the Adjustable water pressure reducing regulator valve rotates to provide a greater water flow to a predetermined stable value, and vice versa. If the sensor reads that the water flow is already stable, the Adjustable water pressure-reducing regulator valve stops rotating. Water is then treated at the Adjustable water pressure reducing regulator valve, where the working mechanism of the available Adjustable water pressure reducing regulator valve is still manual, so in this study, an Adjustable water pressure reducing regulator valve is needed, which is controlled electrically using a DC motor. The motor driver functions as a motor speed regulator, and the gearbox itself functions to strengthen the DC motor torque on the Adjustable water pressure-reducing regulator valve.

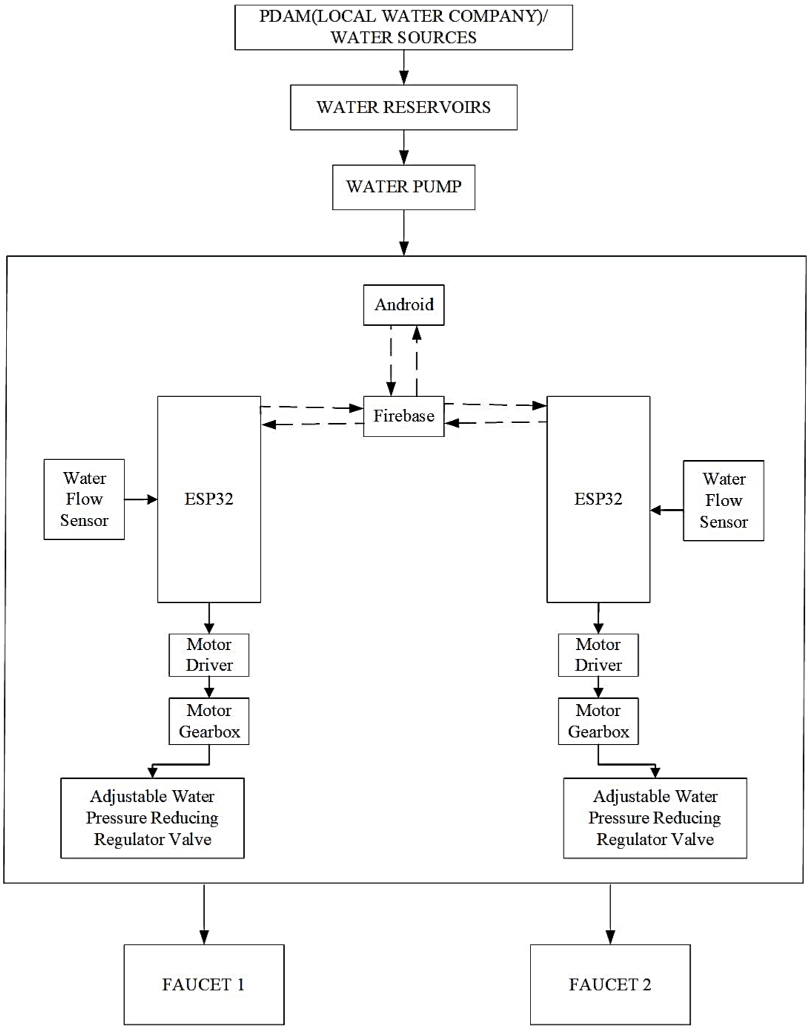

Figure 1. Design Flow Control Device

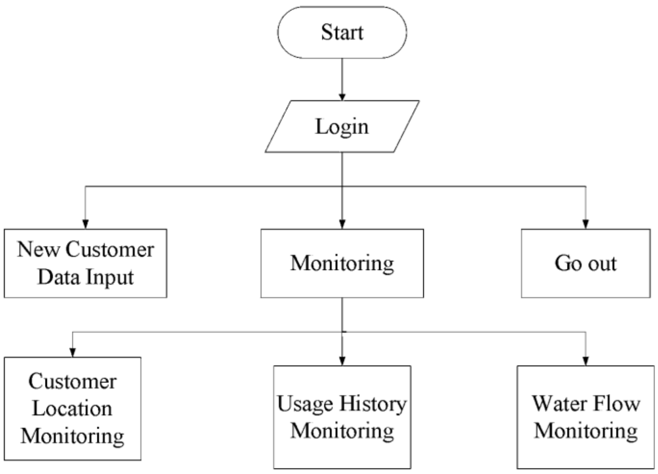

Figure 2. Flow Application Flowchart Design

Figure 2 is a flowchart of the Flow application on the Smart Water Discharge Output Stabilization System on Android-Based Faucets; when the application starts, the user (authorized PDAM employee) is instructed to log in by entering a username and password that has been registered before. Then, the main page displays several monitoring features, namely monitoring customer location to make it easier for users to track the location of customers, usage history monitoring features that can be seen per day, week, or month through graphs, and water flow monitoring features to determine the stability of water discharge output on customer taps and find out the status of customer water flow which is in a low water flow status.

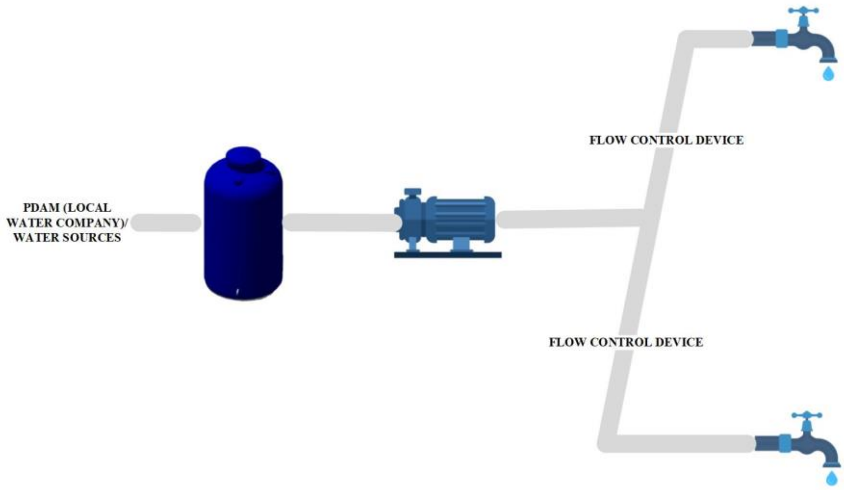

Figure 3. Design Water Stabilization Device

Figure 3 PDAM water that fills the reservoir flows through the pump and is then treated on the flow control device, where this process serves to stabilize the output of water discharge on the tap so that the water filling process becomes faster, minimizes the possibility of damage to pumps or water pipes in water channels that use pumps, and water distribution becomes more regular. After going through the flow control device, water is then released on the tap.

The process starts with PCB printing of the Device Flow Control circuit and tool installation. In the series of Flow Control Devices connected to a 12V adapter consisting of ESP 32, which is used as a microcontroller, the water flow sensor data pin is connected to pin 27, motor driver pin in 1 is connected to pin 21, motor driver pin in 2 connected to pin 4, motor driver output out 1 connected to motor (+) and motor driver output out2 is connected to the motor (-), then also used step-down LM2596 which is used to lower the voltage, motor driver L298N which is used to control the direction of rotation of the DC motor, and water flow sensor which is used to determine the amount of water flow. Moreover, Figure 4 is a picture of the installation of the tool; at this stage, a series of PCBs are installed on the case, and the case is installed on the adjustable water pressure-reducing regulator valve.

Figure 4. Prototype installation

2.2. Testing Scenario

The test scenario in this research consists of testing water flow with and without an Adjustable water pressure-reducing regulator valve as well as testing the water discharge output with and without an Adjustable water pressure-reducing regulator valve. Based on the data collection techniques used, observation guidelines are created to ensure that when conducting trials in the field, the data collected follows the required data.

Table 1. Observation Guide

No	Observation Guide
1	Variable grating water flow measurement without Adjustable water pressure reducing regulator valve
2	Variable grille for water flow measurement with Adjustable water pressure reducing regulator valve
3	Variable lattices measuring the output of water debit at the faucet without Adjustable water pressure reducing regulator valve
4	Variable grille for measuring the output of water debit at the faucet with Adjustable water pressure reducing regulator valve

Table 1 is an observation guideline consisting of a variable grid of water flow measurement without using an Adjustable Water Pressure Reducing Regulator Valve, a variable grid of water flow measurement using an Adjustable Water Pressure Reducing Regulator Valve, a variable grid of measuring water discharge output without using an Adjustable Water Pressure Reducing Regulator Valve, and a variable measurement grid water discharge output using Adjustable Water Pressure Reducing Regulator Valve.

Table 2. Variable grating water flow measurement without Adjustable water pressure reducing regulator valve

No	Observation Variables	Units
1	Water flow when tap 1 is on, and faucet 2 is off	L/min
2	Water flow when tap 1 is off, and faucet 2 is on	L/min
3	Water flow when taps 1 and 2 are on	L/min

Table 2 measures water flow when the pipeline does not use an adjustable water pressure-reducing regulator valve. The purpose of this activity is to determine the amount of water flow when the pipeline does not use an adjustable water pressure-reducing regulator valve by providing three different conditions, namely when one of the faucets is on, one of the faucets is off, and when both taps are on.

Table 3. Variable grille for water flow measurement with Adjustable water pressure reducing regulator valve

No	Observation Variables	Units
1	Water flow when tap 1 is on, and faucet 2 is off	L/min
2	Water flow when tap 1 is off, and faucet 2 is on	L/min
3	Water flow when taps 1 and 2 are on	L/min

Table 3 measures water flow during pipelines using an adjustable water pressure-reducing regulator valve. This activity aims to determine the amount of water flow when the pipeline uses an adjustable water pressure-reducing regulator valve by providing three different conditions, namely when one of the faucets is on, one of the taps is off, and when both taps are on.

Table 4. Variable lattices measuring the output of water debit at the faucet without Adjustable water pressure reducing regulator valve

No	Observation Variables	Units
1	Faucet 1 on	L/second
2	Faucet 2 on	L/second

Table 5. Variable grille for measuring the output of water debit at the faucet with Adjustable water pressure reducing regulator valve

No	Observation Variables	Units
1	Faucet 1 on	L/second
2	Faucet 2 on	L/second

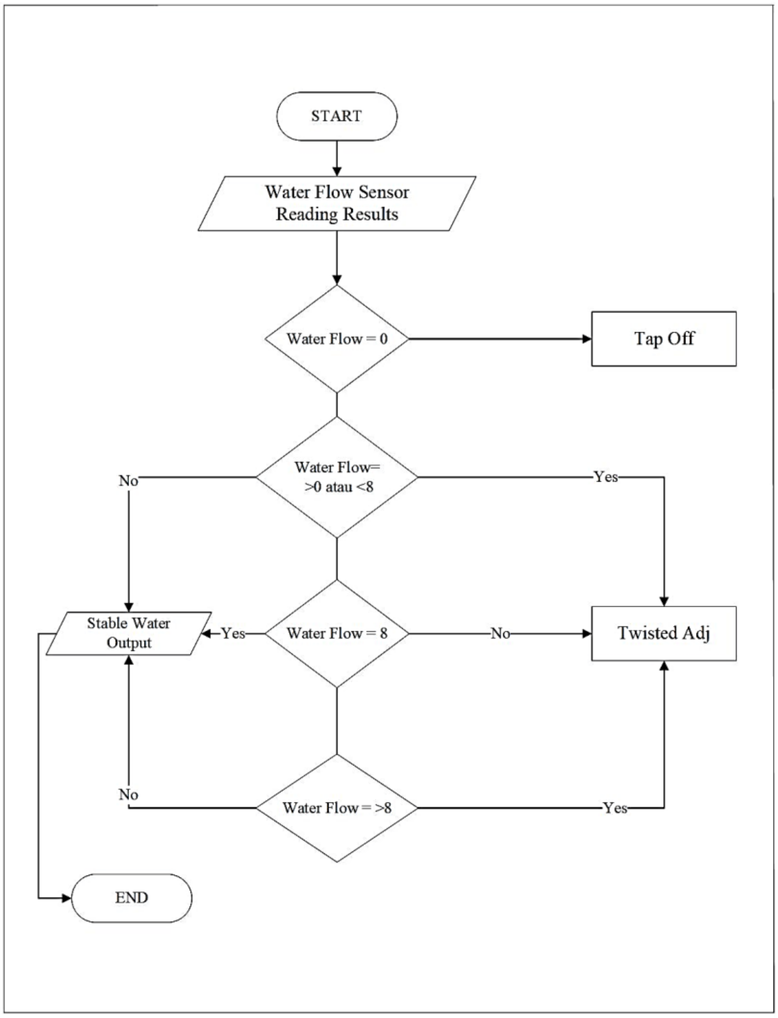

Figure 5. Water Stabilization Algorithm Flowchart

Figure 5 is a flowchart image of the water stabilization algorithm. The value of 8 is used as a reference for the stability of water flow because, from the results of the test of the tool carried out on the Adjustable Water Pressure Reducing Regulator Valve, the maximum reading is 12 liters per minute if only one tap is on, while if two taps are on, the maximum reading is only 10 liters per minute. Therefore, the value of 8 is used as a reference so that when the reading is more than that, the Adjustable Water Pressure Reducing Regulator Valve returns to stabilize according to the predetermined level. If the water flow sensor reading is 0, then the microcontroller sends data to the firebase that the faucet is off. If the water flow sensor readings are >0 and <8, then the microcontroller instructs the DC motor to rotate the Adjustable water pressure-reducing regulator valve wider and sends a signal that the water flow is weakening. If the water flow sensor reading is 8, then the microcontroller signals that the water flow is stable. Then, if the sensor reading results >8, the microcontroller sends a signal to the firebase and instructs the DC motor to rotate the Adjustable water pressure reducing regulator valve smaller so that the water flow decreases to a stable condition.

3. RESULT AND ANALYSIS

The results of this study produced a Smart System for Stabilizing Water Discharge Output on Android-based faucets using an Adjustable Water Pressure pressure-reducing regulator Valve, which functions to stabilize the water discharge output on the faucet. This study aims to produce a design and determine the results of the Smart System for Water Discharge Output Stabilization test on Android-based faucets.

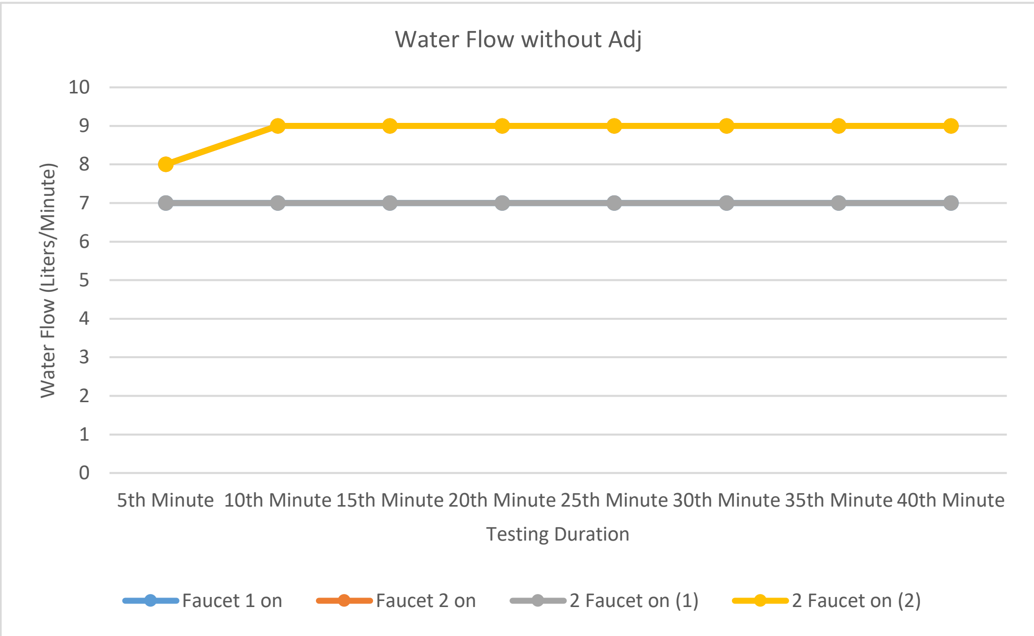

Figure 6. Water Flow Chart without Adjustable Water Pressure Reducing Regulator Valve

Figure 6 shows that when the water flow does not use the Adjustable Water Pressure Reducing Regulator Valve at tap condition 1 on tap 2 off, the average measurement result is 7 liters per minute, which means the water flow on tap 1 is in unstable condition, at tap condition 2 on tap 1 off The average measurement result is 9 liters per minute which means that the water flow on tap 2 is in unstable condition, and in the condition of tap 1 and faucet 2 on average the measurement result is 7 liters per minute on tap 1 and tap 2 is worth 9 liters per minute which means the water flow on tap 1 and tap 2 is in unstable condition. The output of water flow from faucet 2 is greater than faucet 1 due to the location of faucet 2, which is close to the source, so the flow from faucet 2 is greater than the flow of water from faucet 1.

1. Water Flow Measurement without Using Adjustable Water Pressure Reducing Regulator Valve
2. Water Flow Measurement Using Adjustable Water Pressure Reducing Regulator Valve

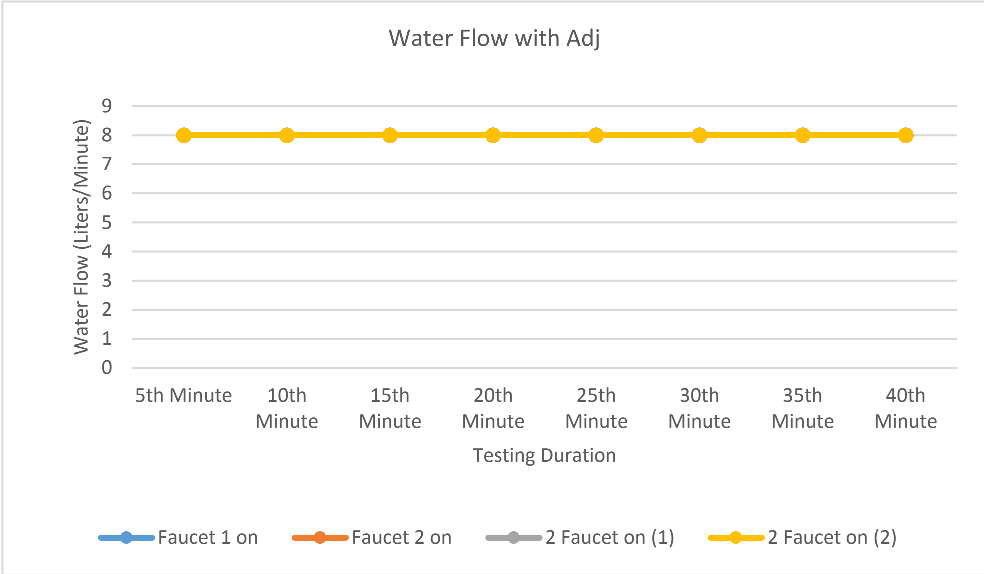

Figure 7. Water Flow Chart with Adjustable Water Pressure Reducing Regulator Valve

Figure 7 shows that when the water flow uses the Adjustable Water Pressure Reducing Regulator Valve at tap condition 1 on tap 2 off, the average measurement result is 8 liters per minute, which means the water flow on tap 1 is in stable condition at tap condition 2 on tap 1 off The average measurement result is 8 liters per minute which means the water flow on tap 2 is in stable condition, and in the condition of tap 1 tap 2 on average the measurement result is 8 liters per minute on tap 1 and tap 2 which means the water flow on tap 1 and faucet 2 is in stable condition.

Table 6. Water Discharge Data without Adjustable Water Pressure Reducing Regulator Valve

Source	Water Volume (L)	Time (s)	Water Discharge (L/s)
Faucet 1	292	2400	0,1216
Faucet 2	353	2400	0,1470
Difference	**61**	**0**	**0,0254**

Table 7. Water Discharge Data with Adjustable Water Pressure Reducing Regulator Valve

Source	Water Volume (L)	Time (s)	Water Discharge (L/s)
Faucet 1	324	2400	0,135
Faucet 2	339	2400	0,14125
Difference	**15**	**0**	**0,00625**

Table 6 shows that the volume of water sourced from tap 1 is 292 liters with a duration of 40 minutes or 2400 seconds resulting in a water discharge of 0.1216 liters per second or

121.6 milliliters per second. The volume of water sourced from tap 2 is 353 liters with a duration of 40 minutes or 2400 seconds, resulting in a water discharge of 0.1470 liters per second or 147 milliliters per second. This measurement shows a difference in water volume between tap 1 and tap 2 of 61 liters and in water discharge between tap 1 and tap 2 of 0.0254 liters per second or 25.4 milliliters per second.

Moreover, Table 7 shows that the volume of water sourced from tap 1 is 324 liters with a duration of 40 minutes or 2400 seconds, resulting in a water discharge of 0.135 liters per second or 135 milliliters per second. The volume of water sourced from tap 2 is 339 liters with a duration of 40 minutes or 2400 seconds, resulting in a water discharge of 0.14125 liters per second or 141.25 milliliters per second. In this measurement, there is a difference in water volume between faucet 1 and faucet 2 of 15 liters and in water discharge between faucet 1 and 2 of 0.00625 liters per second or 6.25 milliliters per second.

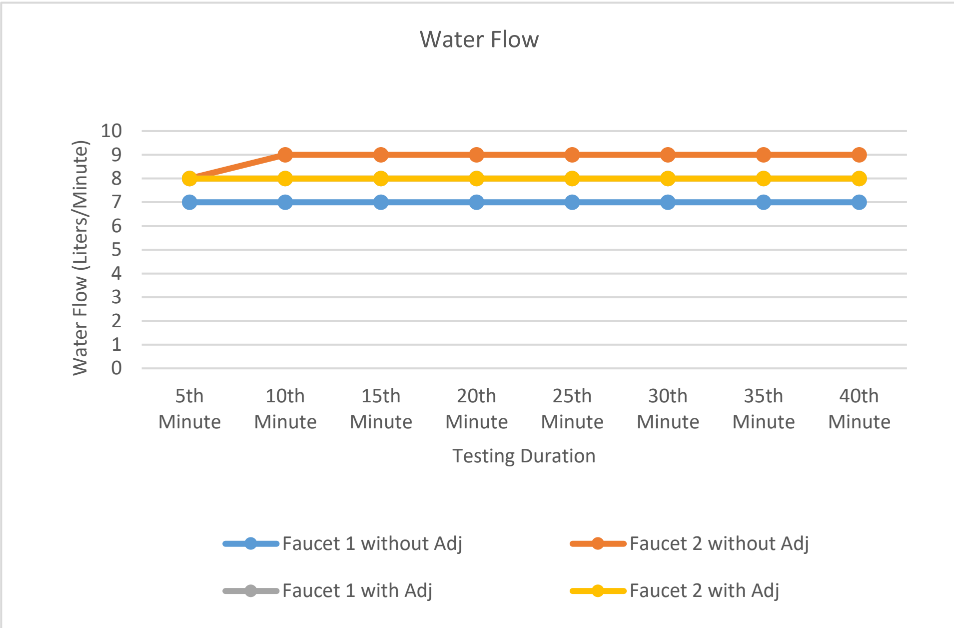

Figure 8. Graph of Conclusion of Water Flow Measurement Results

The Smart Water Discharge Output Stabilization System test result on Android-based faucets can work as expected. This is based on data obtained from the results of system measurement trials, which can be seen in Figures 8 and 9. Moreover, Figure 8 shows that the average results of measuring water flow without using an adjustable water pressure reducing regulator valve on faucet 1 in the 5 minute to the 40 minute are 7 liters per minute, which means the water flow on tap 1 is unstable condition, on tap 2 in the 5th minute which is 8 liters per minute and in the 10 to 40 minute which is 9 liters per minute which means the water flow on tap 2 is in unstable condition unstable. The average results of measuring water flow using the Adjustable water pressure reducing regulator valve on faucet 1 and faucet 2 in the 5 minutes to 40 minutes are 8 liters per minute, which means the water flow on faucet 1 and faucet 2 is in stable condition.

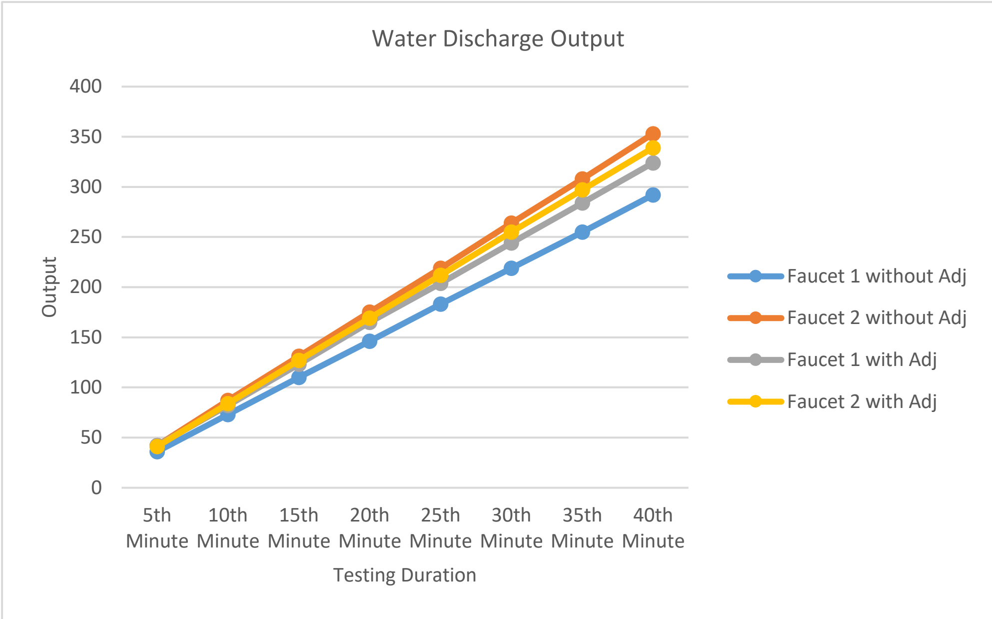

Figure 9. Graph of Conclusion of Water Debit Measurement Results

Figure 9 shows that the output of water discharge without using an adjustable water pressure reducing regulator valve in the 5 minutes is 36 liters on tap 1 and 42 liters on tap 2; in the 10 minutes, it is 73 liters on tap 1 and 87 liters on tap 2, in the 15 minutes is 110 liters on tap 1 and is 131 liters on tap 2, In the 20 minutes, it was 146 liters on tap 1 and 175 liters on tap 2, in the 25 minute it was 183 liters on tap 1 and 219 liters on tap 2, in the 30 minute it was 219 liters on tap 1 and 264 liters on tap 2, in the 35 minute it was 255 liters on tap 1 and 308 liters on tap 2, and in the 40 minutes, it was 292 liters on tap 1 and 353 liters on tap 2. While the results of measuring water discharge output using the Adjustable water pressure reducing regulator valve in the 5 minutes were 42 liters on tap 1 and 41 liters on tap 2; in the 10 minute, which was 82 liters on tap 1 and 84 liters on tap 2, in the 15 minute which was 123 liters on tap 1 and 127 liters on tap 2, In the 20 minutes, it was 165 liters on tap 1 and 169 liters on tap 2, in the 25 minutes, it was 204 liters on tap 1 and 212 liters on tap 2, in the 30 minute it was 244 liters on tap 1 and 255 liters on tap 2, in the 35 minute it was 284 liters on tap 1 and 297 liters on tap 2, and in the 40 minute, which is 324 liters on tap 1 and 339 liters on tap 2. Based on the data above, it can be concluded that the average flow and output of water discharge are more stable when using an Adjustable water pressure-reducing regulator valve than when not using an Adjustable water pressure-reducing regulator valve.

4. CONCLUSION

Based on the results that have been done, it was concluded that the Smart Water Discharge Output Stabilization System on Android-Based Faucets was built using an Adjustable Water Pressure Reducing Regulator Valve on the Flow control device to be able to stabilize output Water discharge on the tap so that water distribution is more efficient, by implementing this system water distribution becomes faster, regular and minimizes the possibility of damage to pipes or water pumps. The results of the water flow measurement show that by using the Adjustable Water Pressure Reducing Regulator Valve, the water flow on faucet 1 and faucet 2 is more stable than not using the Adjustable Water Pressure Reducing Regulator Valve because when faucet 1 and faucet 2 are on, the average output of both taps is 8 liters per minute. The results of measuring water discharge show that the output of water discharge on the faucet using the Adjustable Water Pressure Reducing Regulator Valve is more stable than without using the Adjustable Water Pressure Reducing Regulator Valve because the difference in water discharge output on faucets 1 and 2 is smaller when using the Adjustable Water Pressure Reducing Regulator Valve.

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AUTHOR CONTRIBUTIONS

All Author is responsible for building Conceptualization, Methodology, analysis, investigation, data curation, writing—original draft preparation, writing—review and editing, visualization, supervision of project administration, funding acquisition, and have read and agreed to the published version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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