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LINEAR EQUATION OF SLUICE OPENING HEIGHT AGAINST FLOW VELOCITY WITH WET DEPTH IN IOT-BASED IRRIGATION CANALS IN SUKOANYAR VILLAGE

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ABSTRACT
When using floodgates, which can waste water or even cause a shortage if not used properly, it is crucial to pay attention to the regulation of irrigation water. setting up In this study, the Internet of Things (IoT)-based technology can be used to measure when the floodgates open. Farmers that use this technology can better manage water in irrigation systems and planting systems. This study examines the mathematical relationship between the height of irrigation gates based on the Internet of Things and the hydraulics of the flow in the irrigation canals of Sukoanyar Village, Pakis District. Each door opening height has six points, with four points occurring before the door and two points following the door. The size of the sluice gate, the topography of the canal, and the speed of the water flow are the data that were analyzed for this study. The calculation of the channel geometry values comes first in the analysis process, which is followed by the processing of the flow velocity values for each experimental result. The goal of the five experiments conducted at each place was to directly measure the flow velocity using current meter equipment. Using a nonlinear equation mathematical analysis, the study's findings revealed that the height of the irrigation sluice gate (IoT) has an impact on the change in the canal's dynamics value.

Keywords: *Nonlinear; Irrigation; Internet of Things; Watergates.*

1. Introduction

A suitable irrigation system is necessary for the agricultural system. The dry season and the rainy season are the two seasons that exist in Indonesia. The amount of water possessed by each village varies and generally is smaller during the dry season than during the rainy season when the need for water is not as problematic. To ensure that water is used wisely for irrigation demands, floodgates must be improved for efficiency and effectiveness.[1][2]–[4]. The cropping system in the canals can be improved with the aid of this technique. IoT has been used often in a number of nations [5] through [8]. While there has been prior research conducted in Indonesia itself, it was in a different field. Researchers are studying rivers and IoT using various water resources, river diameters, and agricultural land areas [7]–[10]. Farmers should be able to make use of this system so that agricultural output is maximized and equitable for all agricultural landowners in Sukoanyar Village by integrating the most recent systems and technologies using IoT. There have also been earlier investigations, however, they were carried out in miniature rather than in real life [11]. Since this research was done in the real world, the conclusions were linear equations.

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2. Material and Methods

The study site for this investigation was in the Pakis District of the Malang Regency's Sukoanyar Village. Various stages of the investigation were conducted throughout the research. The initial step involved gathering primary data, such as topographical information, information about the channel's geometry and flow rate (P), and the hydraulic radius (R). Data on flow velocity are analyzed. Channel dynamics analysis comes next. Calculating nonlinear equations and the graphical representation of the door interaction with the channel dynamics data constitute the last stage. The flowchart below provides a general overview of the study that was done. A microcontroller using NodeMCU as the system's brain, relays, and ultrasonic sensors to measure the water level will send a signal to the installed Android, a transformer for power control, a stepper motor to drive the actuator, and connecting cables are used. A car battery as a power reserve, a microcontroller control room, a Water Flow meter (digital discharge meter) connected to a microcontroller, and irrigation sluice gates to open and close the water flow are located between systems. A meter (measuring instrument) and a current meter (flow velocity meter) are utilized to collect various data. This research utilizes six sampling sites to determine the flow velocity sampling point (V) and the channel geometry. Before the sluice, there are four points; after the door, there are two points; see the image below for more information.

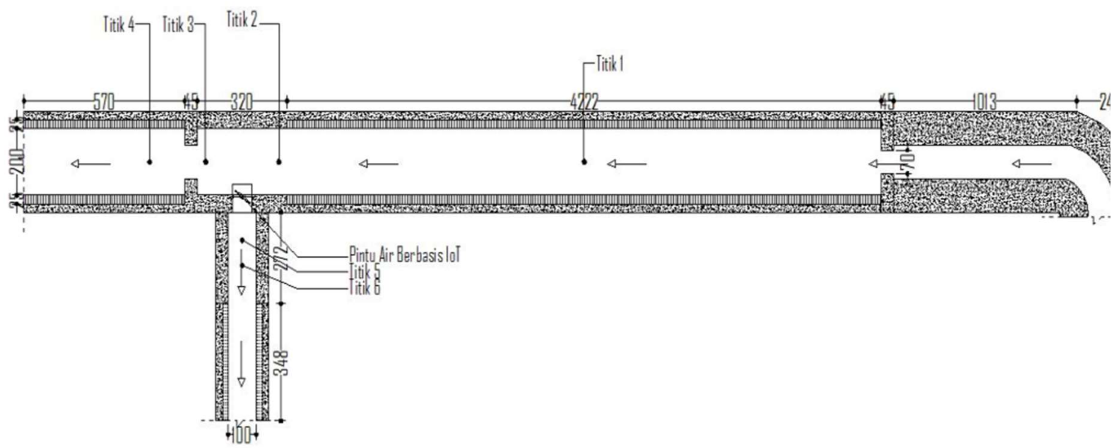

Figure 1. Research Irrigation Channel Plan

3. Result and Discussion

The IoT-based irrigation sluice has an initial opening height of 4 cm and opens periodically. The next stage is to use a gauge at each point to measure the channel's wet depth (h) and geometry. Next, the flow velocity (V) value is measured using a current meter at each point, with five measurements taken at each location. Repeating the treatment with various sluice opening sizes, specifically 6 cm, 8 cm, and 10 cm. Then, every observation is documented. Data acquisition in this study was by recording the results of the above treatment, and the data obtained were processed for data analysis. This analysis aims to determine the flow type, flow rate (Q), discharge coefficient (Cd), and Specific Energy (Es) in open channels with variable door opening heights (4 cm, 6 cm, 8 cm, 10 cm). In the final phase, graphical analysis and linear analysis are performed.

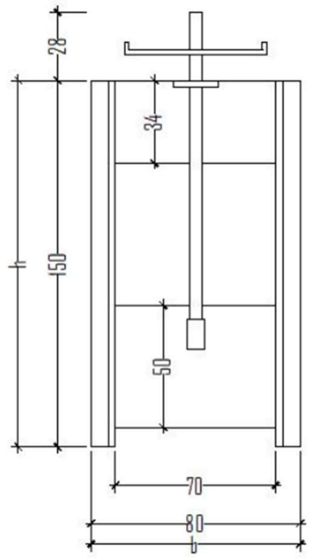

Figure 2. Irrigation Watergate

So to find the wet cross-sectional area (A), use the formula because the cross-section of the channel is square:

$$A = b \times h \quad (1)$$

$$Es = y + \frac{v^2}{2g} \quad (2)$$

$$yc = \sqrt[3]{\frac{Q^2}{g \times b^2}} \quad (3)$$

Graph of the relationship between the variation in the height of the sluice opening to the flow velocity (v) and the wet depth (h).

In Figure 3, the relationship between the flow velocity (V) and the wet depth (h) of the canal at each variation in the height of the sluice opening at the point before the irrigation sluice gate can be seen. The curve graph formed is a linear pattern, namely the ordinate position, which represents the wet depth of the flow, and the abscissa shows the flow velocity. From Figure 4, it can be seen that the higher variation in the opening of the irrigation sluice results in an increase in the value of the flow velocity (V) while the value of the wet depth (h) of the flow drop.

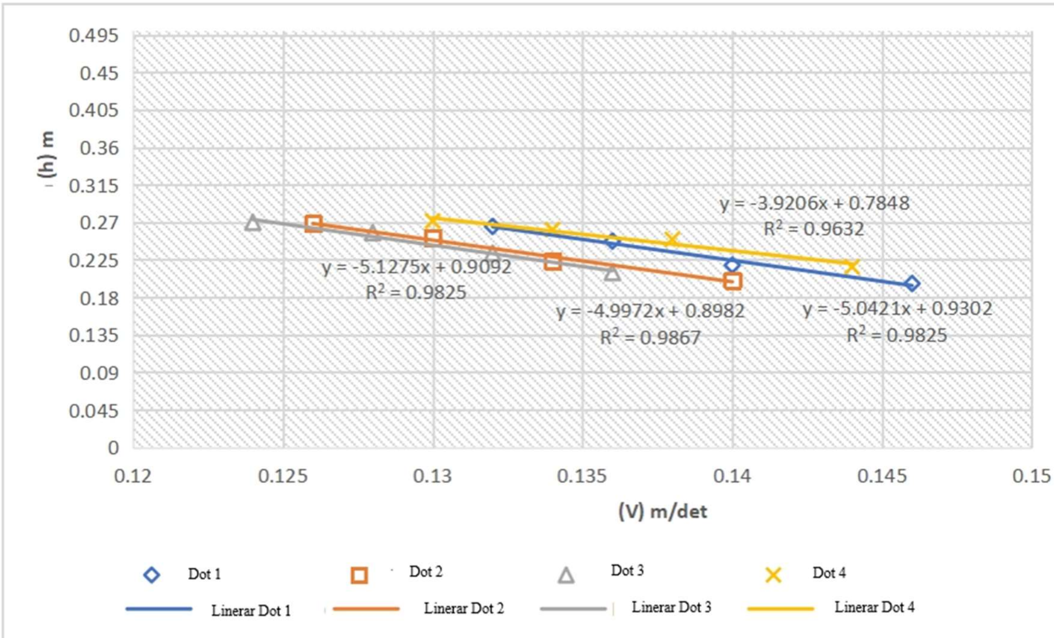

Figure 3. Graph of the relationship between flow velocity (V) and wet depth (h) of flow at each variation in the height of the sluice opening before the gate

4. Conclusions

The research results determined the relationship between the flow velocity (V) and the channel's wet depth (h) at each variation in the height of the sluice opening before the irrigation sluice gate at four distinct locations. The linear equation at point 1 y = -5.0421x + 0 .9302 with a determination value of R2 = 0.9825, a linear equation at point 2 y = -4.9972x + 0.8982 with a determination value of R2 = 0.9867, a linear equation at point 3 y = -5.1275x + 0.9092 with a determination value of R2 = 0.9825, a linear equation at point 4 y = -3.9206x + 0.7848 with a determination value of R2 = 0.9632.

Acknowledgments

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