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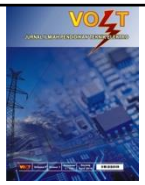

APPLICATION OF FUZZY LOGIC AND SOCIAL MEDIA ON FLOOD HAZARDS EARLY WARNING SYSTEM

Evelina Ginting [1], Nyayu Latifah Husni [1]✉, Tresna Dewi[1], Ade Silvia Handayani[1], Muhamad Rizki Harahap[1]

[1]Department of Electrical Engineering
Politeknik Negeri Sriwijaya, Palembang 30139, Indonesia
E-mail: nyayu_latifah@polsri.ac.id

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Abstract

This research aims to reduce losses that arise because of the flood in a way create a notifier flooding as flood detection. Sensors Ultrasonic sensors measure distance as can be applied as a water level detector, while the sensors used to detect flow velocity of the water flow. Research methods used in the form of literature reviews and making hardware and software using sensors SR04-HC. Application of fuzzy logic is used as a data processing of the ultrasonic sensor and flow sensor. Fuzzy logic will result in a decision on environmental conditions. With the decision made by fuzzy logic, early warning against the danger of flooding, in the form of an alarm and display the text that indicates a likelihood of flooding, as well as to social media news delivery can be carried out.

Kata kunci: flood, fuzzy logic, flow sensors, ultrasonic sensors

INTRODUCTION

Human life is inseparable from the nature around it. Nature provides many benefits to human survival. Forests, lakes, seas, rivers, and some other natural environment provides a wide range of human needs, whether in the form of food, clothing materials, nor the needs of the Board. Based on these facts, it's been selayaknyalah man keep and maintain an environment that is a lot of benefit for them. But unfortunately, the avarice and greed of human

beings often mislead humans, so forget the meaning of preservation of the environment.

The destruction of forests are found in many different areas, the wild lumberjack took advantage shortly by doing illegal logging without thinking of the interests of the next generation of them. The Woods, well be mangrove forests, mangroves or protected forest, the longer the less extent. Zainul Hidayah in his paper (Hidayah, Wiyanto, & Madura (2013), stating that there is a reduction in the total area of mangrove forests in Sidoarjo from 1,236.42 Ha becomes 1,203.35 Ha.

As well as the damage to the River, was a river lot results from sediment carried by the River (Kusumaningrum, Suyanto, & Solichin, 2015) or due to the garbage that accidentally dumped into the river. Human beings are not aware of the danger that threatens them. Abdul ghofur stated that physical changes greatly affect watershed retention watershed surface runoff against (Ghofur & Mahmud, 2016)

The destruction of forests and rivers are the two factors trigger floods, along with other important factors such as rainfall is high, the construction of settlements on the banks of the river and drainage system are ugly (Sebastian, 2008). Flooding can cause a lot of negative impacts, such as: loss of property or loss of life. Fatalities appear due to unpreparedness and lack of information about the floods. The flooding that comes with sudden and so fast cause the victims panicked and confused so trapped in flooded or washed away by torrential flood flows.

The danger of Flooding could have been avoided if society has an awareness of environmental sustainability. However, if the danger of flooding cannot be avoided any longer, not least the impact of the flood can be reduced if the community better prepared to face the oncoming flood. One way is by developing the technology about the dangers of flood notifier will come. Some research in order to provide warning and countermeasures against flood has been done by researchers by making use of SMS gateway (Utami & Cahyanto, 2008), *wireless sensor network*, WSN (Udo & Isong, 2013), social media (Herfort, de Albuquerque, Schelhorn, & Zipf, 2014), (Mandl, Cappelaere, Frye, Evans, & Moe, 2014), (Denis, Palen, & Anderson, 2014), and the flood evacuation system (Knyazkov, Balakhontceva, & Ivanov, S. (2014).

In this research, carried out further development towards applications of social media in order to disseminate information about the existence of the flood. Social media is currently widely used by the public but most social media is used only for entertainment. Therefore, researchers are interested in utilizing social media to spread information as an early detection system supporting the flood.

The system created dealing with the dissemination of information about the height of the water and the speed of water quickly into the community. By utilizing Ultrasonic sensors and sensor water flow, altitude and speed of the water. Ultrasonic sensor utilizing ultrasonic waves reflected water while water flow sensor utilizing a flow of water that is flowing to rotate the blades on the rotor. Rotation of the rotor blades will produce induction will generate electrical energy.

METHOD

In the early stages of research, conducted literature reviews, and then resumed the manufacture of hardware and software. Block diagram of the circuit is one of the most important part in the design of a hardware appliance. From this diagram, it can block

known workings of the whole series are used. Figure 1 is a block diagram of the system used on the notifier of this research.

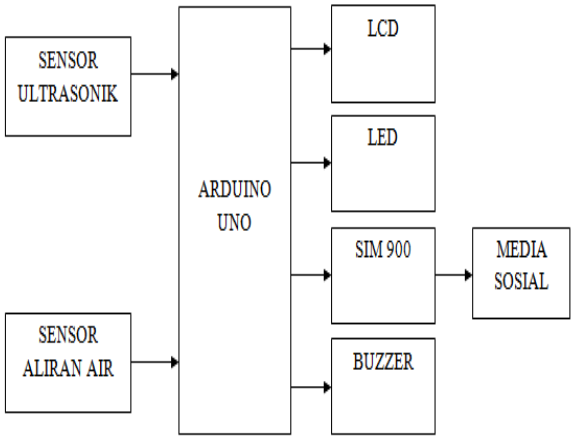

Figure 1. Block Diagram of the notifier of the flood

Ultrasonic sensors SR04-HC used as detector of high water. This sensor is able to detect an obstacle up to a distance of 4 metres. While the Northrop YF-S201 sensor serves to measure the flow of water. It had a limit sensor readings from 1 to 30 L/min. Microcontroller used in this research is the ATMega 128 already embedded microcontroller module on Arduino Uno. LCD, LED, buzzer and sim900A used as the output of the system the notifier. SIM 900 serves as a means of communication between the system's social media with facebook notifier.

Based on the block diagram in Figure 1, the workings of the notifier made in this research are as follows: Ultrasonic sensors SR04 HC- detect the height of the water and the water flow sensor YF-S201 detects the speed of the water, a result of both detection sensor This will be processed by an Arduino using fuzzy logic. SIM900A will send the command to let Social Media Facebook renders the circumstances that have been decided by fuzzy logic, in conditions of security, standby, or danger.

For the design of software, fuzzy logic algorithm on this research, divided into 3 parts, namely 1. Fuzzification process, 2. The process of Inference (Fuzzy Rules), and 3. Defuzzification Process. These three stages can be seen in the following explanation.

Fuzzification process shown by the equation (2) and (3), where the equation of the ultrasonic sensor for fuzzification HC-SR04 shown in equation (2), whereas equation (3) is the equation for water flow sensor fuzzification YF-S201. Figure 2 and Figure 3 is an image of membership function sensor sensor and ultrasonic flow of water. The red line in Figure 2 indicate MF high, normal green color, and the color blue is low. When the ultrasonic sensor detects the value 17 (the value of the distance between the sensors with the surface of the water), then with a great value indicates that there are great distances. This also means that the State of the water level is at a low condition.

$$\mu_{high}(x) = \begin{cases} 1 \text{ if } x \leq 8 \\ \dfrac{12-x}{12-8} \text{ if } 8 < x < 12 \\ 0 \text{ jika } x \geq 12 \end{cases}$$

$$\mu_{normal}(x) = \begin{cases} 0 \text{ if } x \leq 8 \\ \dfrac{x-8}{12-8} \text{ if } 8 < x \leq 12 \\ \dfrac{16-x}{16-12} \text{ if } 12 < x < 16 \\ 0 \text{ if } x \geq 16 \end{cases} \quad (2)$$

$$\mu_{low}(x) = \begin{cases} 0 \text{ if } x \leq 12 \\ \dfrac{x-12}{16-12} \text{ if } 12 < x < 16 \\ 1 \text{ if } x \geq 16 \end{cases}$$

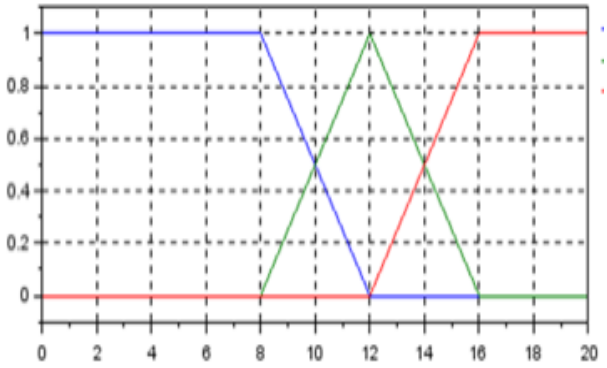

Figure 2. Membership function Ultrasonic sensors SR04-HC

$$\mu_{slow}(x) = \begin{cases} 1 \text{ if } x \leq 5 \\ \dfrac{8-x}{8-5} \text{ if } 5 < x < 8 \\ 0 \text{ if } x \geq 8 \end{cases}$$

$$\mu_{normal}(x) = \begin{cases} 0 \text{ if } x \leq 5 \\ \dfrac{x-5}{8-5} \text{ if } 5 < x \leq 8 \\ \dfrac{11-x}{11-8} \text{ if } 8 < x < 11 \\ 0 \text{ if } x \geq 11 \end{cases} \quad (3)$$

$$\mu_{fast}(x) = \begin{cases} 0 \text{ if } x \leq 8 \\ \dfrac{x-8}{11-8} \text{ if } 8 < x < 11 \\ 1 \text{ if } x \geq 11 \end{cases}$$

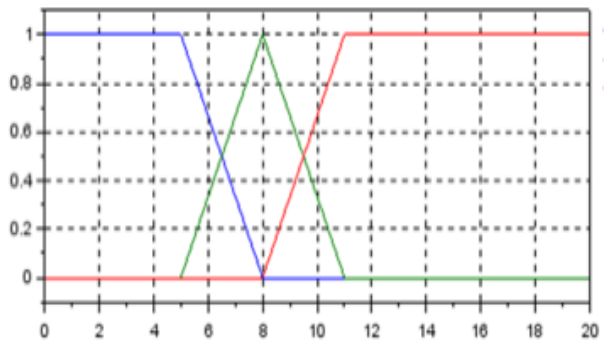

Figure 3. *Membership function of YF-S201 flow* sensor

Blue line in Figure 3 shows the flow of the water is low, the green colour indicates the normal flow, and rapid flow of red color.

Table 1 shows the fuzzy rules of flood detection system consisting of 3 State, slowly, quickly, and normal.

Tabel 1 *Fuzzy Rule*

Rules	HC SR04	YF-S201	Conditions
R1	Low	Slow	Secure
R2		Normal	Secure
R3		Fast	Alert
R4	Normal	Slow	Secure
R5		Normal	Alert
R6		Fast	Danger
R7	High	Slow	Alert
R8		Normal	Danger
R9		Fast	Danger

Defuzzification process is done using the equation (4)

$$z = \frac{\mathrm{W}1\alpha 1 + \mathrm{W}2\alpha 2 + \cdots + \mathrm{W}n\alpha n}{\sum \alpha} \quad (4)$$

where

Z = Defuzzification

W = The Level of Danger (Conditions)

$\boldsymbol{\alpha}$ = Value of *Fuzzy* Rules

In this study, hhen fuzzy set Secure circumstance, flood detection under normal circumstances, the Green LED will turn on and will send you the status of the safe on social media. When the fuzzy set the Standby then flood detection in idle and the yellow LED will lights up, the buzzer will turn on and off every 2 seconds, and will send the Standby status on social media. Whereas when the fuzzy set the danger of flood detector then in danger then the red LED will turn on, the buzzer will continue to light up and will send you the status of the dangers on Social Media.

RESULTS AND DISCUSSION

At this stage, do some testing. Table 2 data for ultrasonic sensor measurement results. In the program settings, Ultrasonic sensors are set by using the maximum limit to detect water up to 300 cm.

Table 2. Measurement of Ultrasonic sensors

High (cm)	*Echo* Voltage (V)	*Trigger* Voltage (V)
9	0.14	0.45
12	0.17	0.58
17	0.24	0.7

Flow sensor YF-S201 on the study, use voltage Vcc of 5 v. The results of measurements of the flow sensor is shown in table 3. Parameters 'Levels' in table 3 indicate the distance Ultrasonic sensors SR04-HC to the surface of the water. Level 17 represent the distances between the Ultrasonic sensors SR04-HC to the surface of the water, or in terms of low water levels. To output measurement results notifier based on fuzzy logic can be seen in table 4.

Table 3. Measurement of flow sensor

Flow (L/min)	***Signal* Voltage (V)**
4	2.04
7	2.22
13	2.54

P Measurement on Ultrasonic sensors performed as many as 3 times, when high water of low value (9 cm); When the high water of Normal value (12 cm); and when the high water of high value (17 cm). To know the low water high, Normal or High, it can be done by comparing the high water by ultrasonic sensor function membership HC-SR04 (as shown in Figure 2). The treatment of the same measurements also performed on the water flow sensor YF-S201, where 3 times measurements are also carried out on the sensor that is when the flow of water is worth the Slow (4 L/min) flow, the Normal value (7 L/min), and the water flow is worth a Quick (13 L/min). The State of the Slow, Normal and fast flow of water can be found by comparing the results of detection of YF-S201 sensor with water flow sensor membership YF-S201 contained in Figure 3. For example when the water reached a height of 17 cm, then fuzzy logic will compare the value with the existing membership:

Low

$x \geq 12,$ $\mu_{\text{high}}(x) = 0$

Normal

$x \geq 16,$ $\mu_{\text{normal}}(x) = 0$

High

$x \geq 16,$ $\mu_{\text{low}}(x) = 0$

From these calculations is obtained that the High value of 0, the Normal value is 0 and the Low-value 1. So 17 cm height (the distance between the sensor with the higher water level) categories include low (high water its low).

When the water flow is at a 7 L/min, then fuzzy logic will compare with your existing membership:

Slow

$5 \leq x \leq 8,$ $\mu_{\text{slow}}(x) = \frac{8-7}{8-5} = 0.33$

Normal

$5 \leq x \leq 8,$ $\mu_{\text{normal}}(x) = \frac{7-5}{8-5} = 0.66$

Fast

$x \leq 8,$ $\mu_{\text{fast}}(x) = 0$

The parameters have been adjusted to Secure value = 20; Standby = 50; and danger = 80.

From these calculations, the results obtained that slowly 0.33, Normal 0.66, fast was 0. Due to the Normal value is greater than the value of Slow water flow, 7 L/min including a Normal category.

The calculation of the value of Z is based on the State of the above can be seen here:

$$Z = \frac{\omega 1.\alpha 1 + \omega 2.\alpha 2 + \cdots + \omega n.\alpha n}{\varepsilon \alpha}$$

$$= \frac{(20x0.66) + (20x1)}{1{,}66} = \frac{13{,}2 + 20}{1{,}66} = 20$$

These values correspond to the data of the measurement results in table 4, the ultrasonic sensor detects when the value is low and water flow sensor detects the Normal rate, it will produce a State of security, it is in accordance with the existing rules.

Table 4. Output Measurements

Level (cm)	Flow (L/min)	Conditions
17	Normal	Secure
17	Slow	Secure
17	Fast	Alert
12	Normal	Secure
12	Slow	Alert
12	Fast	Danger
9	Normal	Alert
9	Slow	Danger
9	Fast	Danger

Table 4 is a table of results measurement, whereas Figure 4 represents a display picture for facebook and social media testing tool notifier, in a Secure State is detected, the alert, and danger.

Figure 4. The display of Social Media facebook and the condition when testing tool.

In Figure 4 (a) LED indicator is green, indicating that the State is at a safe condition. While Figure 4 (b) and 4 (c) displays the LEDS, yellow and red, which indicates that things are on standby and danger.

CONCLUSION

This paper describes the early detection system design flood using Ultrasonic sensors that can detect high water level and flow sensors YF-S201 that functions to detect the speed of the water. Early flood detection system applied with fuzzy has three conditions to be able to detect a flood. From the results of the experiment, it can be seen that the system is already good for an early detection system is used as a flood.

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