*Research Report*

# AWAS (Automatic Water System) as a clean water distribution device to mitigate the impact of climate change

Muhammad Pratama, Mochammad Firmansyah

*Center For Young Scientist, MAN 1 Jembrana, Indonesia, lilikmuntamahpurwanto@gmail.com*

## *Abstract*

In the last 50 years, climate change has caused extreme weather such as drought and other natural disasters. Affected communities by this disaster experience scarcity of clean water. They often scramble and fight over the government's limited source of clean water aid. This problem could be solved by utilizing technological tools and Internet no Things (IoT) to distribute clean water to affected communities. In this research, we developed a prototype based on IoT and data from Family Card (Kartu Keluarga) aimed to distribute clean water evenly to communities-affected areas named AWAS (Automatic Water System). AWAS controlled using IoT based on website application, database, and Wi-Fi that uses microcontroller NodeMCU ESP8266, water flow sensor, and LCD 16 x 12C used to display data provided by Arduino IDE through the program created. The database contains the Family Card number, name, address, and gender of the water recipient. The result from the database was inserted into AWAS program and shown on the website application to manage and operate AWAS. The water flow sensor function to know the amount of water that flows from the submersible pump. AWAS can dispense 3.3L of water in 15 seconds and can be controlled using Arduino IDE. In conclusion, AWAS effectively distributes clean water to communities-affected areas, and the use of family card makes it easier to control the distribution of clean water.

## *Keywords*

Climate Change, Clean Water, Internet of Things, Family Card.

## 1 Introduction

### 1.1 The purpose of the investigation

The biggest problem on earth is climate change that occurs globally. Climate change is an event of changing climate elements in a very long time. There have been several changes in the last 50 years, such as slowly increasing air temperature, increased rainfall, and air pressure [4]. This increase in climate parameters has an impact on extreme weather changes. One of the impacts of climate change is global warming, this causes ice in the north and south poles to melt, resulting in rising sea levels which can have implications for tidal flooding in coastal areas [3]. In addition to tidal flooding, coastal areas are also experiencing reduced groundwater accompanied by rising sea levels which triggers seawater intrusion into the mainland, polluting water sources for clean water and irrigation needs [7].

A study simulating water scarcity and climate change implies that in the future, 1-18% and 0-6% of the global population, namely South Asia and East Asia, are exposed to increased water scarcity due to climate change [5]. Droughts that occur due to climate change make the quality of life decrease. Clean water is a basic need to do daily activities. Because of that, the need for clean water becomes difficult to find and becomes scarce. As happened in Sikka Regency, NTT, due to a long drought, residents were fighting for clean water when clean water aid came from Badan Penanggulangan Bencana Daerah for daily cooking and drinking needs [8]. During the eruption of Mount Semeru, disaster-affected areas such as refugee camps, refugees complained about the difficulty of getting clean water for their daily needs. Clean water aid has flowed, but it is not sufficient for the needs of the refugees, resulting in long queues and fighting for clean water [2].

The struggle for clean water in drought or disaster areas can be solved by utilizing technological tools to distribute clean water evenly and equitably. The advantages of clean water supply technology for emergency responses have the characteristics 1). can be operated with all kinds of water (Flexible & adaptable), 2). Easy to operate, 3). does not require a lot of maintenance (Low maintenance), 4). Few use chemicals (Low chemical), and 5). easy to carry and move (Mobile) [1].

The regulation of Irrigation water that uses the Internet of Things (IoT) is controlled automatically by a microcontroller by adding a water flow sensor as a water flow meter with an ultrasonic sensor to determine the water level. The use of Arduino Uno and Wemos microcontrollers as processors on the device and connected to the Android smartphone via an internet connection is called IoT. IoT allows applications to be connected to all devices for transmitting data to irrigation officers according to the schedule [6]. The tools that are widely used in IoT-based water control suite are:

1. ESP8266 module is an electronic board containing ATMega328 microcontroller. Used for simple to complex electronic circuits and LED controllers.
2. Riley is a tool based on electromagnetics to drive a number of contactors that are arranged and can be controlled from other electronic circuits with electric power as an energy source.
3. Jumper cables are cables used for devices or prototypes that use Arduino and white breadboard. It is used as an electrical cable without the need for soldering.

4. Power Supply is an electronic device that supplies voltage directly to the components in the casing. It is utilized as a voltage converter from Alternating Current (AC) to Direct Current (DC) because hardware components can only operate with DC current.
5. Liquid Crystal Display (LCD) is a device for displaying information with numbers or letters. It is used as a text display tool.
6. Driver is an electronic circuit that serves to supply the current required by an electronic device. This current is controlled by a smaller signal such as a Pulse Width Modulation (PWM) signal.
7. Water pumps are centrifugal pumps. A type of deep well pump with the water level location beyond the suction power of an ordinary pump. [9].

Family Card in Indonesia called Kartu Keluarga (KK) is a document from the local Provincial Government. KK functions as an identity card containing complete data on the identity of the head of the family, family members, the composition, and relationships between family members. Every family must own a family card. The data from this card can be used to determine the number of affected families and the amount of water needed by each family.

Therefore, in this study, we developed a prototype to distribute clean water evenly and equitably by utilizing IoT and data from Family Card. This device is expected to help distribute clean water to residents or refugees experiencing clean water crises evenly and named this device AWAS (Automatic Water System).

The advantages that are expected from the Research performed are:

1. AWAS is expected to be a solution for the government in distributing clean water evenly and equitably to communities affected by a disaster.
2. AWAS can save time and make it easier for communities affected by natural disasters to get clean water by utilizing Internet of Things (IoT).

## 1.2 Problem formulation

Based on the research background described above, the formulation of the problem in this study are:

1. Can AWAS be a solution for the government in distributing clean water evenly and equitably to people affected by natural disasters?
2. Can AWAS save time and make it easier for people affected by natural disasters to get clean water by utilizing Internet of Things (IoT)?

## 1.3 Investigation objectives

The objective of this research is to develop a device to distribute clean water based on IoT and data from Family Cards (KK) so that it can determine the effectiveness of AWAS in distributing clean water evenly to communities in disaster-affected areas.

# 2 Method of the investigation

## 2.1 Type of investigation

The type of investigation is experimental. To make a prototype of the device and to be tested in the Research Laboratory.

## 2.2 Investigation time and place

The investigation has been performed at the Research Laboratory of MAN 1 Jembrana from May to July 2021; and improvement of the prototype carried out in September 2022.

## 2.3 Investigation stages

A. Awas components

The components used to build AWAS prototype is Power Supply, ESP8266 Module, Driver Circuit, 16 x 12C LCD Circuit, Jumper Cable, Submersible Pump.

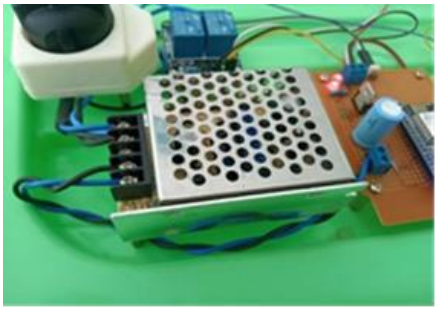

Figure 1: Power supply

Figure 2: ESP8266 module

Figure 3: Driver circuit


Figure 4: LCD 16 x 12C

Figure 5: Jumper cable

Figure 6: Submersible pump

B. Cost for AWAS components

The cost to purchase AWAS components is as follows:

Table 1: Fix cost table

| FIX COST | | | | | | |
|---|---|---|---|---|---|---|
| No | Description | Amount (Unit) | Cost (Rp) | Total Cost (Rp) | Lifetime (Month) | Cost/Month |
| 1 | Container Box 150L | 1 | 190000 | 190000 | 12 | 15833 |
| 2 | ½ inch Pipe | 1 | 14000 | 14000 | 12 | 1166.6 |
| 3 | PCB board | 1 | 8000 | 8000 | 12 | 666.6 |
| 4 | Arduino | 1 | 40000 | 40000 | 12 | 3333 |
| 5 | Water Flow sensor | 1 | 32000 | 32000 | 12 | 2666.6 |
| 6 | LCD (Liquid Cristal Display) | 1 | 20000 | 20000 | 12 | 1666.6 |
| 7 | Aquarium pump | 1 | 140000 | 140000 | 12 | 11666.6 |
| 8 | Power Supply Adaptor 3A | 1 | 25000 | 25000 | 12 | 2083 |
| 9 | Electric Socket | 1 | 23000 | 23000 | 12 | 1916.6 |
| 10 | L Type Pipe Connector | 2 | 3000 | 6000 | 12 | 500 |
| 11 | Jumper Cable | 1 | 17000 | 17000 | 12 | 1416.6 |
| 12 | Elastic Hose | 1 | 30000 | 30000 | 12 | 2500 |
| 13 | Regulator Type 7805 | 1 | 2000 | 2000 | 12 | 166.6 |
| 14 | Resistor | 1 | 15000 | 15000 | 12 | 1300 |
| 15 | Capasitor Rubycon16 v 3.300 UF | 1 | 2500 | 2500 | 12 | 208 |
| 16 | LED Light | 1 | 500 | 500 | 6 | 83 |
| 17 | Relay Module 2 Channel | 1 | 23000 | 23000 | 12 | 2000 |
| 18 | Spacer | 14 | 1500 | 21000 | 12 | 2000 |
| | | | **Total Fix Cost** | **609000** | **Total Fix Cost Per Month** | **51172.8** |
| | | | | **39,39 USD** | | **3,31 USD** |

Table 2: Variable cost table

| VARIABLE COST | | | | |
|---|---|---|---|---|
| No | Description | Cost (Rp) | Amount | Total Cost (Rp) |
| 1 | PVC Pipe Glue | 4300 | 1 | 4300 |
| 2 | Soldering Tin | 12000 | 1 | 12000 |
| | | **Total Variable Cost** | | **16300** |
| | | | | **1,05 USD** |

C. AWAS prototyping

1. Power Supply circuit, this circuit consists of electrical terminals from PLN (State Electricity Company) and is connected to an adapter so that the power output is 12 V.
2. Database creation sequence, using local XAMPP server for inputting the number of Family Cards that ESP8266 will access, and create a website application to be accessed by users.
3. ESP8266 programming circuit, in this circuit, a program is inserted to run the AWAS system using the Arduino IDE. (Figure 7) The working scheme of the AWAS application can be seen in the block diagram (Figure 8).

Figure 7: Arduino IDE

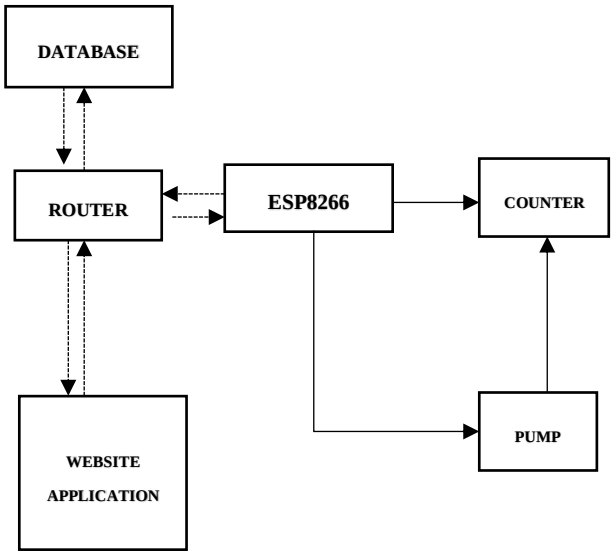


Figure 8: Block diagram

D. AWAS prototype testing

AWAS prototype application was tested by entering the Family Card number on the website. The result is that water can flow according to as specified in the ESP8266 circuit, as much as 3300mL in 15 seconds.


Figure 9: AWAS prototype testing

# 3. Result of the experiment

## 3.1 The suite of AWAS

A. Power supply circuit

The power supply receives a power source and lowers the voltage, directing the electric current into a 12V (DC) voltage that will supply the entire suite. The regulator circuit will regulate the voltage from the Power Supply to a 5V voltage and supply the ESP8266 as the primary circuit.

B. Database Circuit

The databases are created based on the Family Card and inputted on the local XAMPP server. Data input on XAMPP is still done manually. This database will be accessed by ESP8266. In XAMPP, we insert a website application that will access the database and make it easier for users to manage the database.

C. ESP8266 module

The ESP8266 will check the data from the database; if the data is available, it will be forwarded to Riley, which functions to drive the pump. If the pump is running, the water flow sensor placed at the outer end of the pump will calculate the amount of water that comes out and has been set. Determination of the amount of water that comes out is regulated by the ESP8266, which has been programmed with the Arduino IDE.

## 3.2 Work mechanism of AWAS

To use this application is very easy. First, ype the Family Card number on the website application then clicks the Search Data button. The website application will display the name of the family Card, address, gender, and status of the water recipient, specifically (0) for those who have not received and (3300) for those who have received clean water. If the status is (0), then click the Open Faucet button, and the water will flow as much as 3300mL (Figure 10).

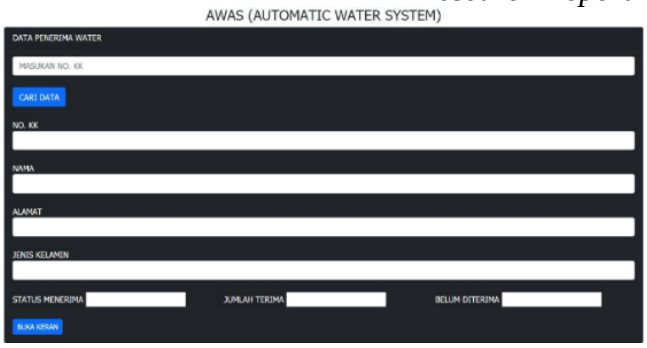


Figure 10: Website application

In the Flowchart (Figure 11). It can be seen that the program used requires a local network connectivity and electricity. If the electricity supply is inaccessible in disaster areas, AWAS could use solar electric supply, and the internet could use mobile tethering.

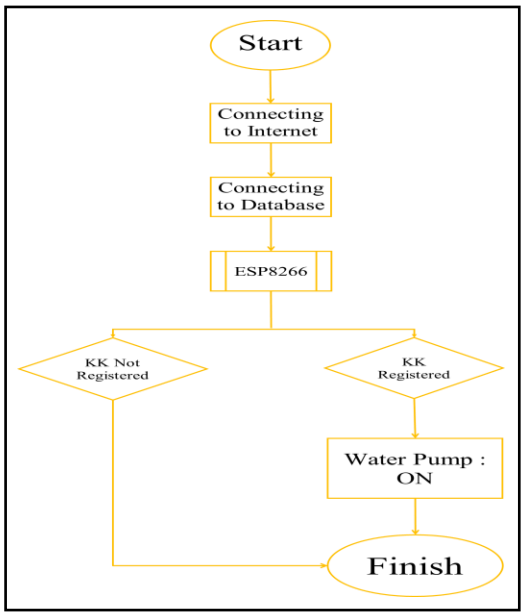


Figure 11: Work mechanism flowchart

## 3.3 AWAS prototype testing

The test is performed by one time opening the faucet, and the faucet will drain as much as 3300mL of water. It means that for one rotation of the pump will flow 0.332mL. This amount can still be changed as needed by changing the programming on the Arduino IDE. As a future development, the number of water recipients can be adjusted to the number of Family Card members.

## 3.4 AWAS application in disaster areas

In disaster areas, clean water is vital to maintain health. The data inputted into the database is based on the affected family, thereby minimizing those not affected by using the limited supply of clean water.

The use of a database based on Family Cards will reduce the potential for scrambling and unequal distribution of clean water in one group only. It is hoped that, with this application, the distribution of clean water will run in an

orderly manner, no scrambling, and truly meets the needs of the communities affected areas.

### 3.5 AWAS advantages

The advantages of AWAS includes:

1. Easy to use by anybody, just by entering the number of Family Card (Kartu Keluarga).
2. Able to distribute water evenly among Communities affected areas.
3. Affordable to make with parts easy to accessed on public market

## 4 Conclusion

### 4.1 Conclusion

Based on the results of the research that has been performed, it can be concluded that:

1. The AWAS (Automatic Water System) prototype effectively distributes clean water evenly and equitably to communities in disaster-affected areas. AWAS can release the amount of water is 3.3 Liters/15 seconds.
2. The use of Family Card (Kartu Keluarga) number makes it easier to control the distribution of clean water.

### 4.2 Future work

Based on the results of research that has been performed, some suggestions and future works that can be given are as follows:

1. The AWAS (Automatic Water System) prototype is recommended as a reference device that the government can develop to make it easier to distribute clean water evenly and equitably to disaster-affected communities that lack clean water.
2. The next stage will be an Android-based application that can be used to operate AWAS (Automatic Water System).

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