DEVELOPMENT OF MONITORING SYSTEM FOR HERBAL DRINK FERMENTATION PROCESS

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Abstract. The process of monitoring and recording fermentation of the herbal drink based on pH level takes a lot of effort when using pH digital, especially when there are many fermentation drinks to be monitored. With the fast development of the Internet of Things (IoT), it has become convenient to develop a system that is accessible through website and mobile application. In this research, the system is designed and developed to monitor and record the data sensor during the process fermentation of herbal drink. With the help of IoT, it enables the user to monitor the data sensor for the fermentation process and record that data to the database. The user also will get notification of the threshold of pH level when it reaches a certain level through email and phone notification. The system is developed by using Raspberry Pi 3B, several sensors, Arduino UNO, and ESP8266. There is also a mobile application that will be used that is a BLYNK application.
Keywords: Herbal drink, IoT, Web development, Fermentation, Sensors, Mobile application

1. INTRODUCTION

The way to monitor many fermentation drinks takes time and a lot of effort for entrepreneurs who pursue a business in the making of fermentation drinks. One of the examples is the making of traditional herbal fermented drinks. To monitor and keep track of the drink fermentation process is a major key to ensuring that the drink has reached the point of the best quality. Therefore, it needs a system that offers a low- cost device that helps the business owner to maintain and gather information about the several key parts of the element inside the drink such as the pH level of the drink. There are several methods of checking the pH level of the drink to determine if the drink has reached a certain pH level. One of the options is using a digital pH sensor to check out the pH level. However, it takes effort and time to monitor and record every fermentation drink from one drum to the other. If they have a large number of drums to be checked by using a digital pH sensor, it will be hard to track the information pH level of the drink during the fermentation process. With that being the case, the flexibility of using such technology to address this problem is becoming a way of creating an IoT (Internet of Things) system that monitors information about the pH- level of each gallon along with the temperatures and humidity. These are displayed on the mobile application and web server which later stores it to the database which later can be analyzed as it is converted to CSV (Comma-Separated Values) format. The help of the website makes it easier for the user to supervise the current information about the fermented drink but also to record the information on the database. Implementing this system in the real world of business will benefit many entrepreneurs who have a business on fermentation herbal drinks.

2. Literature Review

Literature reviews that will be explained and discussed in this chapter will all be related to the development monitoring system that is implemented in the

fermentation process herbal. The following mind map framework discusses several topics that include web development, IoT, pH level, Herbal drink, and Database. These topics have more information to be explained in detail which is shown in the sub- topics to get to know more about what the specific requirements need to be fulfilled.

a. Herbal Drink

Herbal drink can be utilized for treatment and health support. Despite its bitter taste, it has for centuries been important within the lives of most Indonesian individuals. Basic Health Research Data (Riskesdas) in 2010 showed 60% of Indonesia's population over the age of 15 said that they have drunk herbal drink for medication, and 90 % of them said that there were benefits to drinking herbal drink for medication [19]. There are different types of traditional herbal drinks. The author's recipe for an herbal drink can be seen in Table 6 where there are many types of leaves that are used for making a traditional herbal drink

Table 1 Herbal Drink

Local Name	**Latin Name**
Daun Kelor	Moringa Oleifera
Daun Pepaya	Carica Papaya
Daun Sirsak	Annona Muricata
Daun Pegagan	Cantella Asiatica
Daun Temurui	Murraya Koenigii
Daun Kersen	Muntingia Calabura

b. Honey

Honey is a product that comes from bees that has high value as it is useful for many different purposes such as treatment, maintenance of health, natural preservative, food, and beverage sweeteners. Different types of honey are available and can be found in different places. It can be seen in Table 7 where some countries produce a lot of specific honey.

c. Fermentation

Fermentation has been known for a long time as it became part of science in 1857 when Louis Pasteur found out that fermentation is a result of specific reactions in microorganisms. There are various meanings of fermentation according to experts from biochemistry and microbiology. From the perspective of biochemistry, fermentation is related to energy generation with the process of catabolism of organic compounds. On the other hand, Industrial microbiologists say that fermentation is related to the process of production of products with the help of microorganisms as biocatalysis [22]. In general, fermentation is a way to convert substrates into products of certain desires by using specific microbes.

3. METHODOLOGY

a. The steps above are explained as follows:

1. Define Problems

Define what the problems to be solved in this research are.

2. Define Objective & Hypothesis

Determine the objective and hypothesis for this research.

3. Define Research Scope & Limitation

Determine the limitation of this research as well as the research scope.

4. Collecting Information From Study Literature and Other Sources

In this stage, reading some literature and other sources such as books and journals can identify what instrument is suitable to be used for this research and understand how the process of fermentation for herbal drink works.

5. Design and Develop Monitor System Herbal Fermentation Process

In this stage, designing the architecture of the system on how each device is well connected becomes a system that functions to collect data from the sensor and sends it to the servers to be stored.

6. Perform Testing and Collecting Data

When the system has already passed the testing validation, the system will try to collect real data from the drum that is used

for fermentation of herbal drink for days and send the data to the servers.

7. Analysis Data

When the data is already stored into the database, it can be analyze how pH changes occurs for many days as it takes for the herbal drink during the fermentation process to reach minimal point where the drink is ready to be drink.

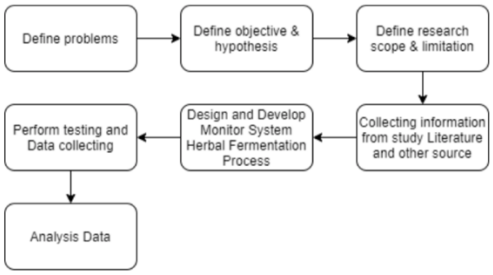

Figure 1 Research State

b. Time and Location

The location for this research was in the author's house. The two drums that are used to hold the water of the herbal drink for the fermentation process are placed at different locations. The first drum was put in a room at temperature 28°C, the second drum was placed in a room at temperature 29°C. These two drums will be monitored and recorded temperature, humidity, pH level of the herbal inside the drum by using data acquisition devices that include sensors and microcontrollers.

c. Testing Method

To ensure if the system works properly, there are several methods used.

The methods are:

1. Doing the calibration of the pH sensor to verify the accuracy the measure the pH level of the drink in the process of fermentation.
2. Ensuring that the data from each sensor is sent to the server of BLYNK application and Raspberry Pi 3 Model B.
3. Ensuring that the system notification for threshold notification is working properly.

4. Result

It is important to design architecture of the system to build a reliable and an effective system, by showing the integration between each device and how it is connected. Figure 10 shows the system architecture of the monitored herbal fermentation process where the word 'Station' is referring to the drum that holds herbal drink that will be monitored and recorded by using the data acquisition devices. In this system implementation, there is only one drum that will be monitored and recorded which is for 'Station-1' as supposed that the system is capable of running more station until 'Station-X' as depending how many data acquisition device are available. This data will be sent through an internet service provider where it uses a router to send the data from data acquisition devices to the servers. The servers will receive the data and display based on its server capability as the Raspberry Pi 3B server shows the data through the website. Meanwhile the BLYNK server can be seen in the mobile application as it is displayed by using widgets that are available in the mobile application.

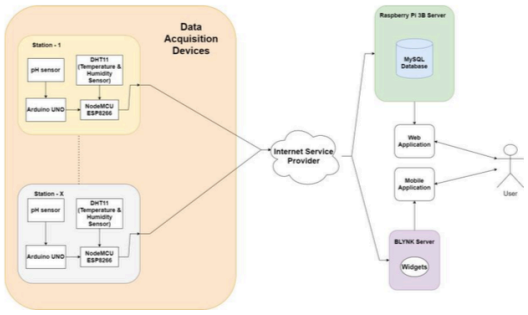

Figure 2 Design Ariticture System

a. Functional Hierarchy

A physical hierarchy of the system can be seen in Figure 11 below where it shows the breakdown of functionality of many subsystems that each have their goals to achieve one goal, which is to work as a system. It is broken down into 3 subsystems where it shows the component and goal of each subsystem that is required to build the system.

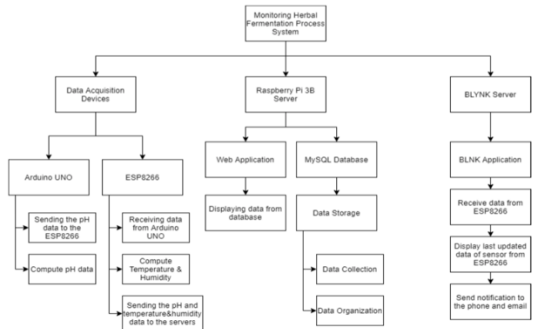

Figure 3 Functional Hierarchy

b. Figure 5 shows the design of the system in the form of a physical hierarchy that is the collection of components in the system that work together to achieve a goal, which is creating applications for the user to monitor the fermentation process of the herbal drink. It starts with the sensor modules that are required to collect the data based on its functionality, ESP8266 will act as Wi-Fi client to establish communication with the router for accessing the internet. ESP8266 also acts as a BLYNK client to have communication with the BLYNK server. There are two applications that will be used, which are from Raspberry Pi 3b server through web browser and the mobile application for the BLYNK application.

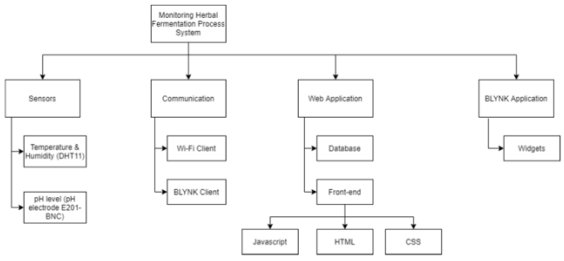

Figure 4 Physical Hierarchy

c. Flowchart

Flowchart shows the sequential order of the workflow system that was created to show the breakdown of processes that are running on the system. It consists of a symbol that has its own function, starting from showing the input or output, process, and decision which goes from start to end. The devices that are used for collecting data are explained in the flowchart to see the process of each device being programmed.

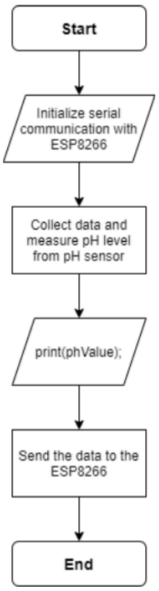

Figure 5 Arduino UNO Flowchart

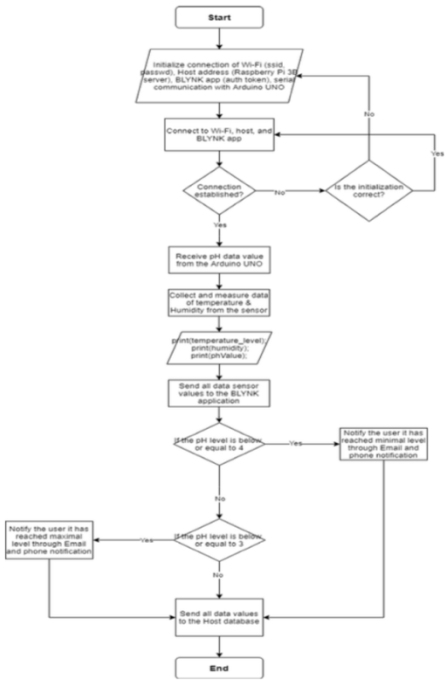

Figure 6 NodeMCU Flowchart

d. Interface

In order to send the updated data from the sensor to the Raspberry Pi 3B server where the data will be shown in the web browser, this data went into different files of php that have each functionality. Figure 15 shows the data flow from ESP8266 to the web browser. The data first is sent to the

filename 'write data.php' where the receiving request from ESP8266 with the GET method is storing the data to the Database of MySQL. After the data is already stored, filename 'connection.php' will read the data and send that data to the filename 'index.php' so then it can be shown in the web browser.

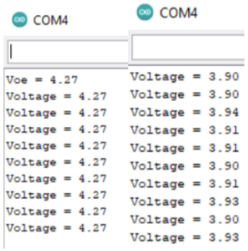

Figure 7 Measurement of PH Sensor

Figure 8 BLYNK Application

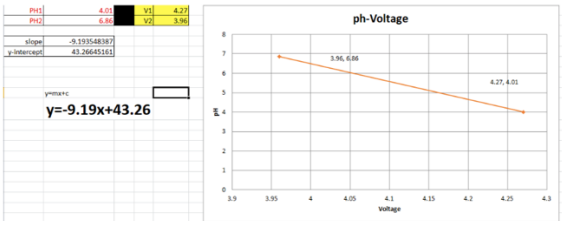

Figure 9 Linear Equation

5. Conclusion

The main objective of this thesis is to develop a system able to monitor and record the fermentation of herbal drinks by collecting data sensors and sending it to the servers which are accessible for the user to monitor in the website and mobile application. One of the old methods to check out the pH level of the drink is by using a digital pH digital sensor, and it is still being used nowadays. However, this method to monitor the fermentation process of herbal drinks in large numbers takes time and a lot of effort has to be made for recording. Therefore this research aimed to create a system that facilitates users to monitor and record the fermentation process of herbal drinks. The system architecture for monitoring is developed throughout the research and some testing was done as well.

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