DEVELOPMENT OF OIL LUBRICANT LEVEL MONITORING SYSTEM ON RESERVOIR BASED ON INTERNET OF THING (IoT)

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Abstract. IoT (Internet of Thing) - based technology development is growing rapidly. This research is developed an IoT-based application to monitor and measure the level capacity of Diana PS lubricating oil (oilDOP) as one of the important ingredients in the compound manufacturing process which functions as a softener that determines the level of hardness of the compound. This system is made to be accessible through the web desks and mobile web, using HC-SR04 ultrasonic sensor and Nodemcu esp8266 microcontroller with php and html5 programming languages and a database using MYSQL. Based on this research, it is found that the volume reading results on webphone and webdesk based applications are the same and produce realtime data so that it can be used as a periodic reporting. and can solve the problem of monitoring and controlling OilDOP tank volume.

Keywords— monitoring, level, internet of thing

1. INTRODUCTION

The research was conducted in an effort to overcome the problems that occur in oilDOP filling from the drum oil to the storage tank currently still done manually, when the oil is at the lower level, the warning light will turn on and the operator will turn on the pump motor by pressing the button. To note that oilDOP is one of the important ingredients in the process of making a chemical compound, which functions as a softener that determines the level of hardness of the compound. This compound is a basic material for the manufacture of various types of rubber products for the automotive industry such as polymers, fillers, carbon, shockbreaker dampers, engine mounting etc.

The problem that occurs here is that there is a human error in the operator who does not see the warning light and causes the pump motor cannot be turned off on time. Warning lights are used because there are no indicators on the storage tank at this time to determine the amount of oil needed to make the storage tank volume full. As well as inaccurate information about the amount of oilDOP material used in the production process of compounds for a certain period of time that is needed during the evaluation process and calculation of oilDOP material requirements, especially during monthly reports.

With an average oilDOP usage in a month of about 6,066 liters for one production machine so that the oil storage tank is needed to maintain oil availability. Besides that, the use of oil for every day is uncertain depending on the daily production schedule so monitoring must be carried out to find out the volume of oil in the storage tank to determine daily oilDOP usage and stock checking in a certain period.

2. RELATED WORK

The research was conducted after conducting a literature review of several previous studies, namely:

Research has been carried out with the aim of monitoring water quality (WQM) using an Internet of Things (IoT) -based system. This system is designed by embedding Radio Frequency Identification (RFID), Wireless Sensor Network (WSN) and Internet Protocol in one platform. The radio frequency used for WSN communication placed in the vegetation area is 920MHz. The water parameters measured in this proposed system are the pH level using an analog pH sensor. The ambient temperature is captured during pH measurement using an analog temperature sensor. All WSN nodes are deployed in a real environment on the lake in the Universiti Sains Malaysia (USM) campus area for performance evaluation. Instead of using the 2.4GHz ZigBee protocol, the Digi Mesh 920MHz protocol is proposed to be implemented for monitoring water quality in the vegetation area because of its ability to exceed signal attenuation. This system prototype is evaluated in a real environment to ensure that the main function of the pH measurement process follows the design requirements. Several experimental analyzes were carried out including energy analysis and reading range communication analysis to study the overall performance of the system. [1].

The design and implementation of the IoT system has been done using ultrasonic sensors used to measure water levels. Other parameters such as pH, TDS, and water turbidity must be calculated. Calculated values from sensors can be processed by microcontrollers and uploaded to the internet via a Wi-Fi module (ESP 8266). Analysis can also be done on perceived data to find solutions. In the design of various controllers such as Arduino Uno, Raspberry PI b + is used as a core controller. The system is created using several IoT modules to access sensor data from the core controller to the cloud. Data obtained from sensors can be displayed on the internet and provide facilities to filter data on cellphones or web applications. [2].

The development of the Internet of Things (IoT) water level monitoring system can already be implemented in a future smart village in India which includes system prototype design and implementation including the description of equipment and technology needed for system development. [3].

A system that is useful for observing water quality based on Internet of Things (IoT) has been designed. This system uses a microcontroller module and a Zigbee module to make a Wireless Sensor Network (WSN) which has a low level and is more efficient. Furthermore, to monitor data from all corners of the environment Raspberry Pi is used to create gateways and cloud computing technologies on the internet, especially for the provision of user-friendly web browser applications. [4].

A Wireless Sensor Network (WSN) based greenhouse condition monitoring system has been designed. This system uses a temperature, humidity, CO_2 content and light detection module. Furthermore, the modules are integrated and combined with wireless sensor network technology and control technology for automatic control and greenhouse management. [5].

WSN-based systems have been designed and implemented for agriculture to monitor temperature, soil conditions and humidity. This system uses ZigBee and GPS technology for operations [6].

A new technique is proposed to keep track of water levels in water systems in tanks. Users can send messages to the system to find out the water level details on the tank and also be used to adjust the pump spontaneously by turning off the pump when the critical water level in the tank is reached and sending a message to the user that the water in the tank is full. This is intended for water level control with the support of ultrasonic sensors and GSM technology [7].

An automatic water level control system has been created using a controller that can be updated using GSM technology, namely SMS notification. The advantage of this system is that it is relatively free from interference and has an effective transfer of action. This water level control system can be used in homes, offices, swimming pools and industrial sectors. This system can be modified into two tank systems with wireless communication between towing tanks and reservoir tanks. Although categorized as a smart system that has many things to improve, it can be considered for its use as a smart system through improvements to its shortcomings. [8].

Based on the results above, the researchers designed and implemented an Internet-based Thing (IoT) level control system.

3. METHODS

This research uses a planning approach including :

- Observation

In this observation phase, an inspection was carried out on the production section to find out directly from the existing conditions and see the problems caused mainly in monitoring oil and filling oil in the storage tank. The plant sketch can be described in Figure 1.

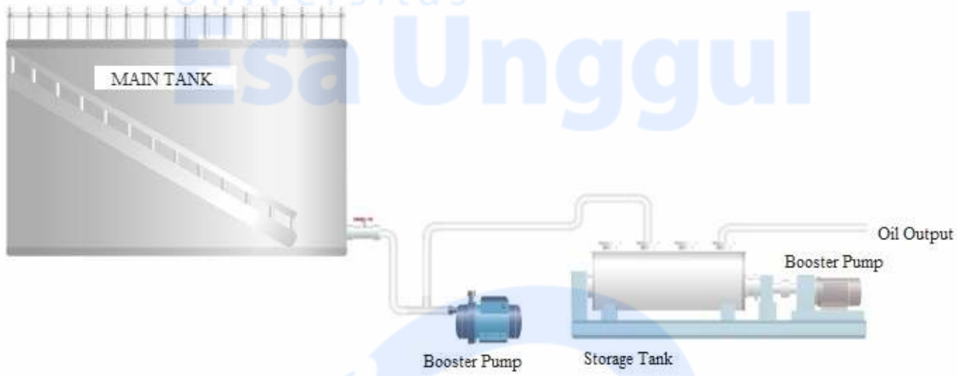


FIGURE. 1. Plant Object of Research

- Defining the real problem

At this stage determine the factors that influence the existing problems, namely. (1) There is no display that shows actual oil capacity, (2) The filling method is still manual, (3) There is no reference to the time needed in filling the oil in the reservoir so that it will be overflow, (4) Measuring of Oil capacity is still manual.

- Development of alternative solutions

As the alternative is development stage to solve the existing problems by designing software and hardware for monitoring and oil control systems in the storage tank.

- Selection of optimal solutions

At this stage the choice of the solution is done by taking a solution, namely the manufacture of a NodeMCU esp8266 based monitoring and control system and an ultrasonic sensor.

- Hardware Design

At this stage, what was done was designing hardware to read the volume value of the oil tank using an ultrasonic sensor and controlling the oil tank filler pump and monitoring the volume of the oil tank processed by microcontrollers and raspberry pi3.

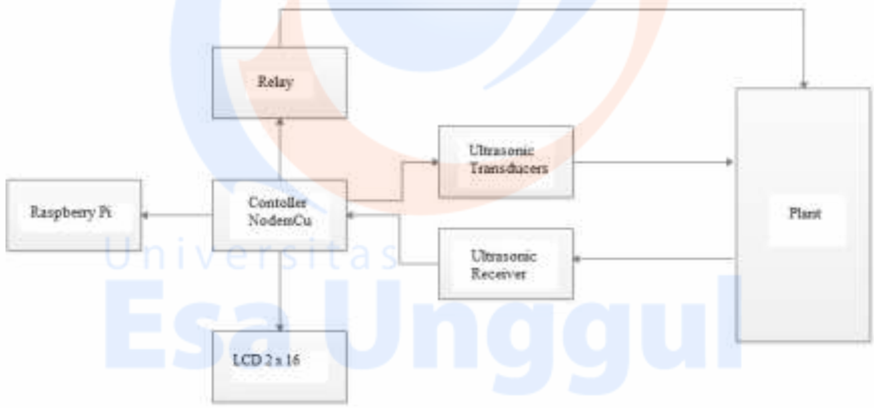


FIGURE. 2. Block Diagram of Hardware Design

- Software Design

Designing a database interface for storing data results from reading tank volumes sent from hardware and designing an Android-based monitoring application interface. Use Case Diagram describes the interaction of use cases and actors where actors can be people. use case describes the system functionality that must be fulfilled, the system from the user view contained in this system is as follows:

1) Admin who has access rights to monitor actual oil capacity, make oil usage reports and print oil usage reports

2) Operator who has access rights to monitor actual oil capacity and control the oil filling relay in the storage tank.

Use Case Diagrams can be seen in Figure 2 below

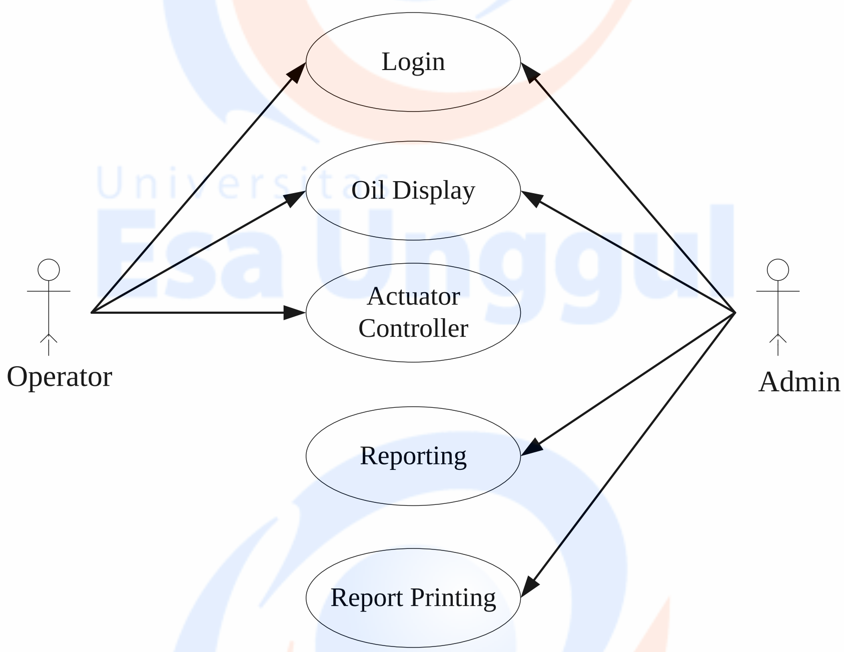


FIGURE. 3. Use Case Diagram

Activity Diagram consists of 2 activity including Admin Activity and Activity Operator. Admin activity starts with login and if it is successful, then proceed with the activity: monitoring, preparing reports and printing reports.

Monitoring activities consist of monitoring the actual condition of oil and monitoring oil filling. Reporting activities consist of reporting oil use and oil requirements on production. Report printing activities consist of printing oil usage reports and oil requirements. Activity diagram can be seen in figure 4 below.

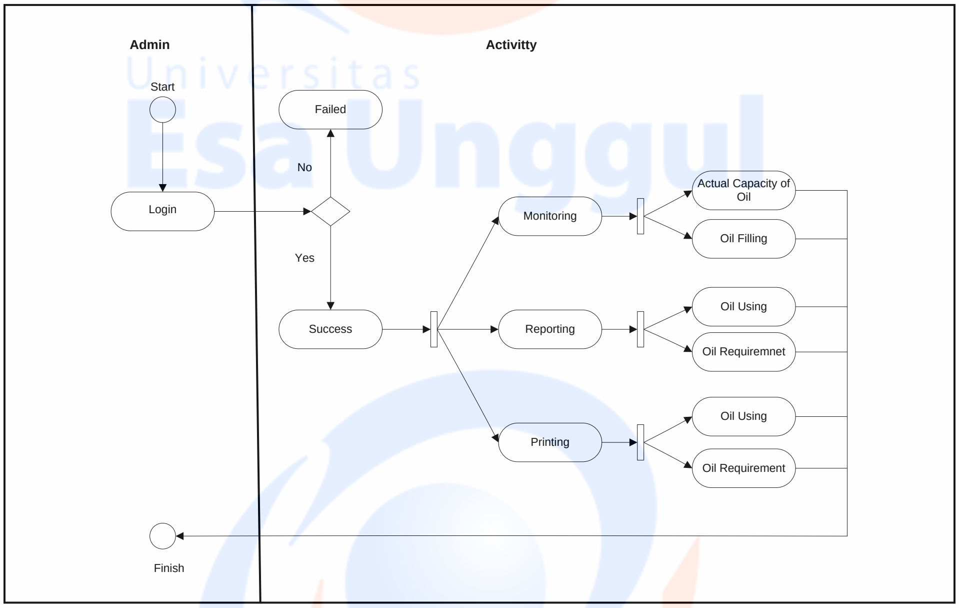


FIGURE. 4. Admin Activity Diagram

Whereas the operator's activity starts with a login, and if successful it will be followed by a monitoring activity which is monitoring the actual level of oil and oil filling. Other activities are controlling namely: filling oil and turning off oil filling. Activity diagram can be seen in figure 5 below.

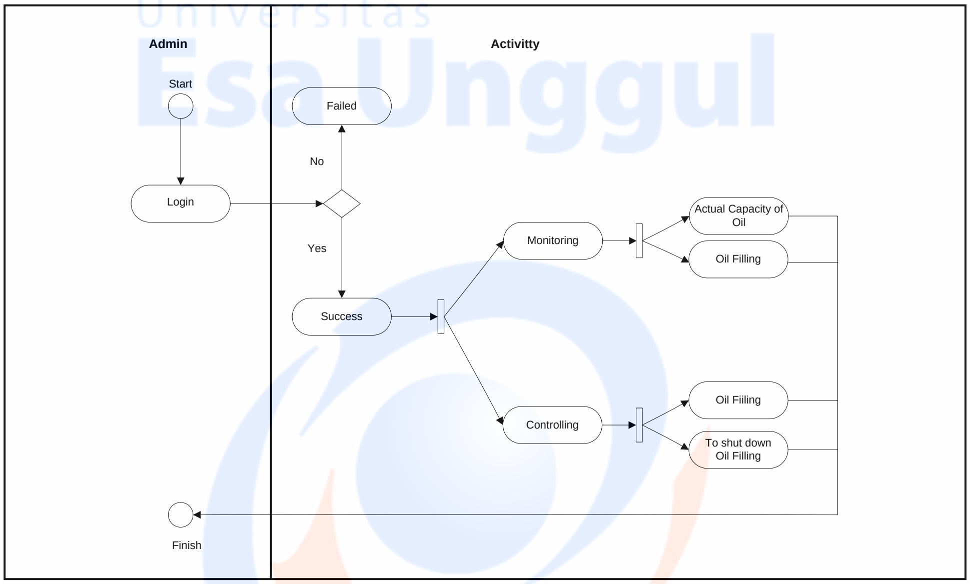


FIGURE. 5. Operator Activity Diagram

Use case requirement can be deployed on table 1 below.

TABLE I. USE CASE REQUIREMENT

N0	REQUIREMENT	ACTOR	USE CASE
1	Before entering the application, it must log in first by entering username and password	Staff, operator	Login
2	Can see oil level or capacity in real time.	Staff, operator	Oil Display
3	Can control the faucet to fill oil or close the faucet.	Staff, operator	Filling faucet control
4	Make reports, use oil, oil capacity	Staff	Make a report
5	Print report on oil usage	Staff	To Print Report

- Implementation

  Based on the design of hardware and software. The hardware circuit is shown in the figure 6 below.

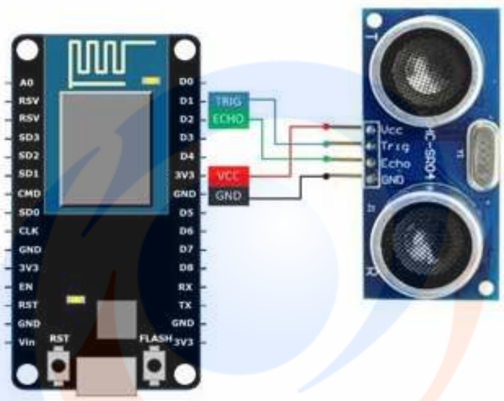


FIGURE. 6. Implementation of Censor Circuit

In Figure 6, the ultrasonic sensor HC-SR04 circuit is a sensor that functions to change the physical quantity (sound) to an electric quantity or vice versa. The way this sensor works is based on the principle of wave reflection.

The results of sound wave reflection are used to interpret the existence (distance) of the oilDOP surface with a certain frequency (generally at 40kHz). HC-SR04 ultrasonic sensor, coupled to Esp 8266 NodeMCU with configuration as shown in the figure. Whereas in Figure 7, there is a 16x2 12C LCD connected to the NodeMCU ESP 8266.

NodeMCU is an open source IoT platform. Consists of hardware in the form of ESP8266 System On Chip from ESP8266 made by Expressive System. It can be analogous to an Arduino microcontroller connected to ESP8622. NodeMCU has inserted ESP8266 into a board that has been integrated with various features like a microcontroller and access to Wi-Fi and also a communication chip in the form of USB to serial. So that in programming it only requires a USB data cable. Because the main source of the NodeMCU is the ESP8266 especially the ESP-12 series which includes the ESP-12E. Then the features owned by NodeMCU will be similar to ESP-12. To write NodeMCU microcontroller programming code esp8266 v1.0, can use the Arduino IDE application, because the structure of the language used is the same

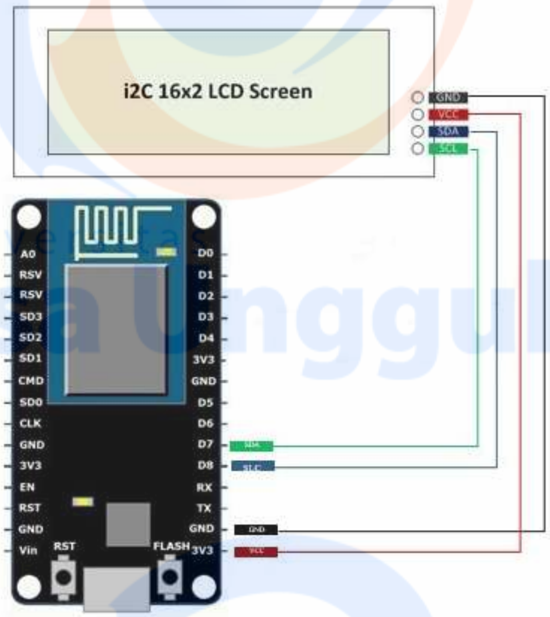


FIGURE. 7. Implementation of Censor Circuit

Once connected between the ultrasonic sensor, NodeMCU Esp 8266, LCD and Relay, then integrated with Raspberry Pi for data processing. Raspberry Pi is a mini computer that has a Broadcom BCM2835 (SoC) chip system, with a 700 MHz ARM1176JZF-S processor (firmware includes a number of "Turbo" modes so users can try overclocking, up to 1 GHz), and is equipped with Video Core IV GPU, originally sent with 256MBRAM, then upgraded to 512MB and equipped with a built-in hard disk or solid-state drive, but uses an SD card to boot and long-term storage.

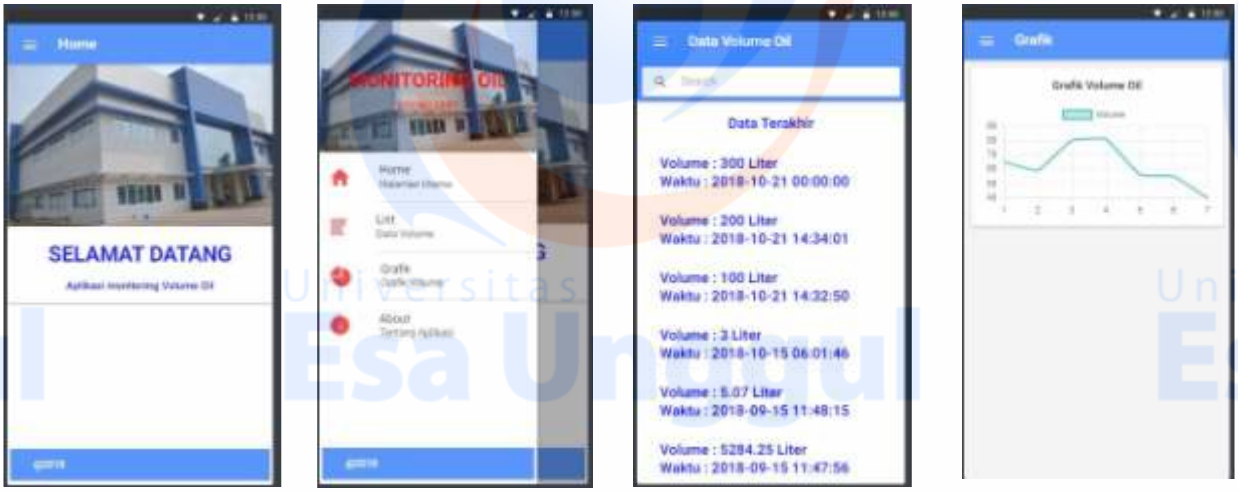
All hardware is arranged according to the design configuration in Figure 2. Programming (Coding) is done using the PHP and HTML5 languages that are compatible with mobile web-based platforms so that the implementation of of the interface displayed on the mobile device can be seen in the mobile platform is generated as shown on result of research.

If the oilDOP level has reached a level that has been set up, the system will instruct the relay to move the actuator in the form of a check valve located on the pump to close the inlet pipe to the tank so that the pump is off and the flow stops.

4. RESULTS

Based on the integration of hardware and the creation of software applications based on web phones and web desktops, the results shown in the picture are as follows (some data samples are taken).

Webapps (Webphone) home page views can be seen in figure 8.a) below. And when clicked on the home button, the display will appear as shown in figure 8.b). Then if you click the Volume Data List button, the display will appear as shown in figure 8.b). And if click graphic button, it will be appear like in figure 8.c). And if click graphic button, it will be appear like in figure 8.d).



(a) Homepage (b) MDI Form (c) Volume Data List Page (c) Graphics Form Page

FIGURE. 8. WebApps Application

The display on the webdesk is shown as in Figure 9 below.

FIGURE. 9. WebDesks Application Volume Data List Form

And the graphics of volume data list at webdesk application, is shown in figure 10.

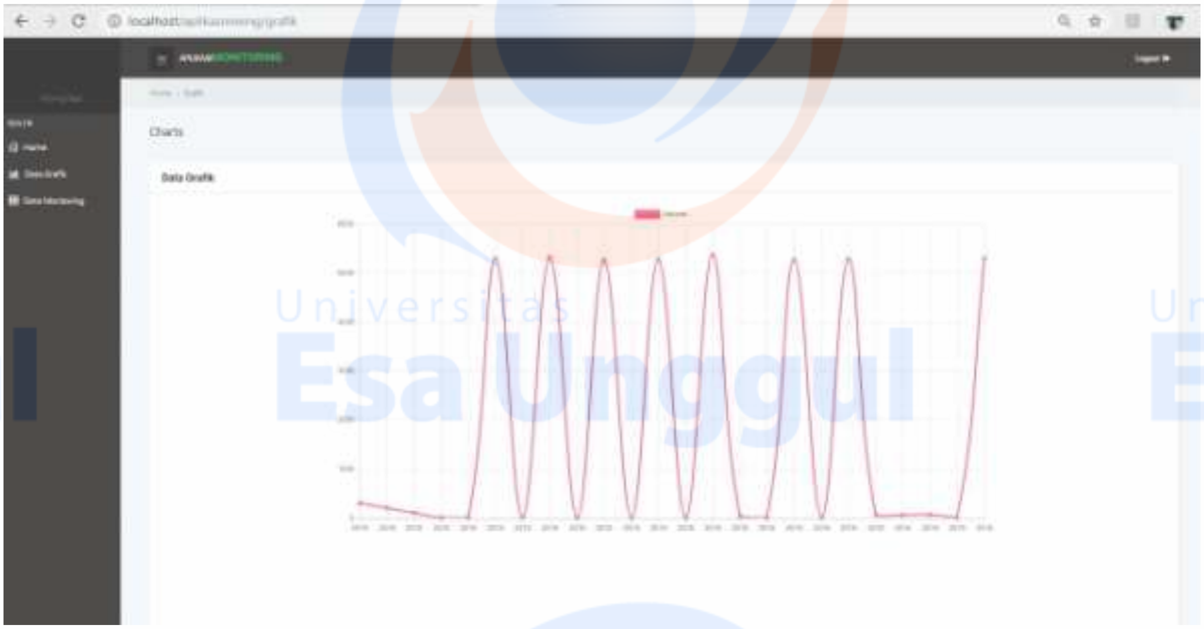


FIGURE. 10. WebDesks Application Graphics of Volume Data List Form

The use of two platform bases, namely webphone and webdesk, to make it easier for the operator to know when the reservoir tank must be filled and when to be turned off through the application planted on the cellphone. While for the admin can monitor to make reports periodically through the application webdesk installed on the computer. And for policy makers it will be easy to make the right decision because it is supported by real time data.

The test results on the data obtained at the same time, between the appointment of the webapps (webphone) and the webdesk application can be seen in Figure 10 and Figure 12, which can be seen in Table 2 below.

TABLE II. COMPARISON OF VIEWS BETWEEN WEBAPPS AND WEBDESK

NO	WEBAPPS (LITRE)	DATE/ TIME	WEBDESK (LITRE)
1	5,07	2018-09-15/ 11.48.15	5,07
2	3	2018-10-15/ 06.01.46	3
3	100	2018-10-21/ 14.32.50	100
4	200	2018-10-21/ 14.34.01	200
5	300	2018-10-21/ 00.00.00	300

From table 2 above, it can be seen that at the same time the appointment of reading on webphone based applications and web desk based applications shows the same magnitude. This shows that the system made is correct.

Based on the system time response that is calculated from the start ON until the relay is ON the actuator so the pump turns on an average of 1 second. Likewise when activating the OFF button on the application. This is because the internet data transmission time is affected by the speed and capacity of the server. also the life time factor of the sensor used also needs to be taken into consideration considering the sensor works on oil liquid

Even so, this system has the advantage of being able to record oilDOP volume data at any time so that periodic usage of OilDOP can be reported to be compared with requests from relevant departments

5. CONCLUSION

Based on the research that has been done it can be concluded that the system has been successfully made to monitor the level of oilDOP in the tank by using HC-SR04 ultrasonic sensor, NodeMCU8266 microcontroller and Raspberry Pi3 minicomputer and control the flow into the tank. This can be seen from the test results, the reading on the webphone subsystem is the same as the reading on the webdesk subsystem so that it can be concluded that the system is correct.

Based on the system response time calculated from starting ON on the web phone application until the relay is ON the actuator so the pump turns on or vice versa when starting the OFF button on the application is clicked on average 1 second. This is because the internet data transmission time is affected by the speed and capacity of the server.

In this study the lifetime of the ultrasonic sensor has not been considered. For this reason, further research can be done using other types of ultrasonic sensors

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