A Prototype of Oufall Temperature Monitoring at Steam Power Plant Using Blynk Application

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Abstract. A Steam Power Plant is a power plant that produces a considerable amount of heat energy. Therefore, a power plant must have a device that serves as a coolant or commonly called a colling system. Colling systems can be sourced from several media; one media commonly used in seawater. However, the continuous use of seawater as a media colling system in this power plant can negatively impact if the colling system's water output has a hot temperature above the provisions. This will disrupt marine life around the colling system's water dump or commonly called downstream canals. This problem has been anticipated since the beginning of the establishment of the Steam Power Plant, namely by making a long and winding canal path so that the water temperature of the colling system output can drop to adjust the temperature of seawater. However, this method was not equipped with the device to monitor the water temperature downstream of the canal compared to the temperature sensor in the condenser outlet. A technology based on the Internet of Things (IoT) was designed with this problem. Microcontroller Nodemcu ESP 8266 as the primary internet-connected device and DS18B20 temperature sensor used to measure water temperature downstream of the canal. The data received by the microcontroller will be transmitted to the blynk application continuously through an internet connection. It can be concluded that the steam power plant operators could monitor water temperatures downstream of the canal easily, remotely, and continuously through android-based mobile applications that constantly connect to the internet.

Keywords: Steam Power Plant, Outfall, Temperature, Internet of Things, Nodemcu ESP8266, DS18B20, Blynk

1 Introduction

A steam power plant is a power plant that uses steam power as the main driver of turbines to generate electric power. This system works by using water as a working fluid. Water is converted into steam in a steam boiler (boiler). Out of the turbine, steam is inserted into the condenser with a coolant derived from water, both fresh and seawater, so that it melts again before the water is pumped back into the steam kettle. The main task of this cooling water is to take the heat from the condenser. Thus, this cooling water has increased in temperature. Steam power plants have by-products in the form of hot water whose temperature is higher than the

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temperature of the water before it is used for cooling. The amount of cooling water needed depends on the maximum capacity of the units in the Steam Power Plant. In general, the use of cooling water at full load for each megawatt is required as much as between 45 - 55 1/ second.[1] However, the continuous use of seawater as a medical cooling system on this power plant can negatively impact when discharged back into the sea. Suppose the cooling system output water has a temperature that exceeds the provisions of the seawater quality standards that the government has set in the Decree of the Minister of Environment No. 51/2004 and regulation of the Minister of State Environment No. 08 Th 2009. In that case, it will disrupt marine biota around the dump or commonly called downstream canal or outfall.

An outfall is a dumping ground cooling system from steam power plants. If the waste heat discharged into the sea does not match the normal temperature of the ocean, then biota life in the sea around the disposal of waste heat by steam power plants will be disrupted.[2]

This has been anticipated since the beginning of the establishment of the Steam Power Plant by creating a long and winding canal path. Thus the temperature of the cooling system water output can drop. However, this method has not been equipped with a tool to monitor the water temperature downstream of the canal. Therefore, the idea was to install a temperature sensor downstream of the canal. This circuit installation project aims to monitor the water temperature downstream of the canal directly and easily. The data obtained was used to compare the temperature of the cooling system water output in the condenser outlet, or can be called the upstream canal. The comparison results can be used to analyze the condition of the canal and the condition of the cooling system water output that flows back into the sea.

This technology has the concept of the Internet of Things (IoT). The Internet of Things (IoT) is a concept that aims to expand the benefits of continuously connected internet connectivity.[3] The technology uses the Nodemcu ESP 8266 microcontroller as the primary internet-connected device and the DS18B20 temperature sensor to measure canal water temperature. Data received by microcontrollers will be sent to the Blynk android application as a controlling or monitoring tool so that data can be monitored remotely and in real-time.

The purpose of this tool is that the operators and environmental teams can easily monitor temperature parameters in an outfall and in real-time through the android-based Blynk application from any place connected to the internet network.

2 Literature review

Indriyanto, Syifa, and Permana conducted a study that applied designing and creating a temperature monitoring system in IoT-based koi seed ponds. The hardware used was the NodeMCU ESP8266 development board, the DS18B20 temperature sensor, relay, and water heater. The system can monitor the pool water temperature and stabilize the pool's temperature automatically using a heater.[4]

Another study by Rivalt Alfaro Tamasoleng, Ellia K. Allo, Janny O. Wuwung developed IoT based design of a Water Value Monitoring Tool on Swimming pool. In this study, the quality monitoring of the swimming pool used three monitoring parameters: pH, TDS (ppm), and temperature. pH parameters used pH sensors, PPM parameters used TDS sensors, and temperature parameters used DS18B20 temperature sensors. The data from each sensor were processed by Arduino Uno and sent using WiFi Module ESP01. The data could be seen in the blynk application installed on the smartphone.[5]

Pikatan, in his study, investigated the applied automatic temperature monitoring and control system on vaname shrimp farm water using internet of things-based esp8266. This system used NodeMCU as its microcontroller embedded ESP8266 module as a data transmission module over WiFi. The water temperature detection tools used were the ds18b20 sensor that could read temperature - 55 °C to 125 °C and the digital thermometer as a comparison.[6]

Based on some previous literature, research on temperature monitoring in the steam power plant area with ds18b20 sensors using blynk applications has not been conducted. Thus this research was needed to develop existing technologies.

3 Method

3.1 Installation plan

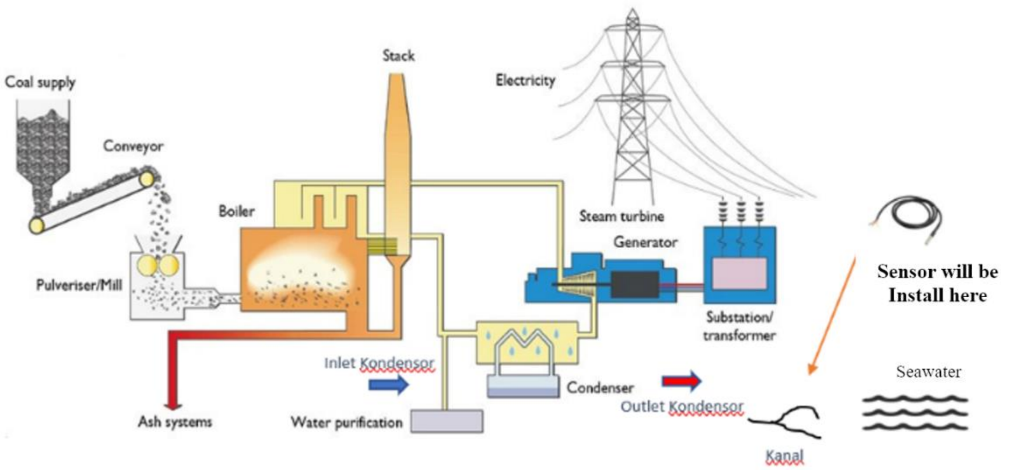


Fig. 1. The main system of steam power plant.

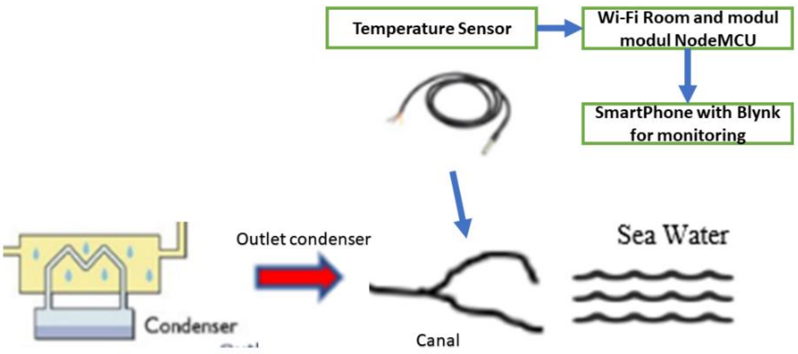


Fig. 2. Sensor installations on a canal (outlet condenser).

Figure 2 explains where the project was being implemented. Temperature sensors were installed downstream of the Steam Power Plant canal, while a series of nodemcu and internet routers were installed at the nearest security post. The downstream canal was the meeting point between the water output cooling system (outer condenser) with seawater.

3.2 Block diagram

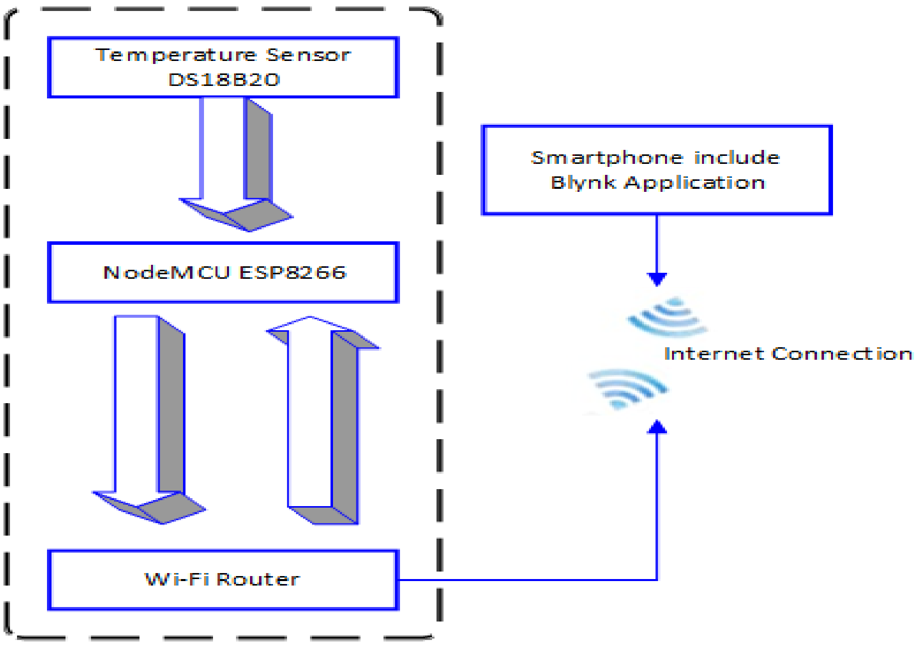


Fig. 3. Block diagram system.

Figure 3 shows a block diagram that describes the working order of the tools created. The data obtained by the DS18B20 sensor would be received by NodeMCU and then sent to the server computer, and then the data could be seen through an android smartphone when the user ran the application that has been made.

3.3 Hardware installations

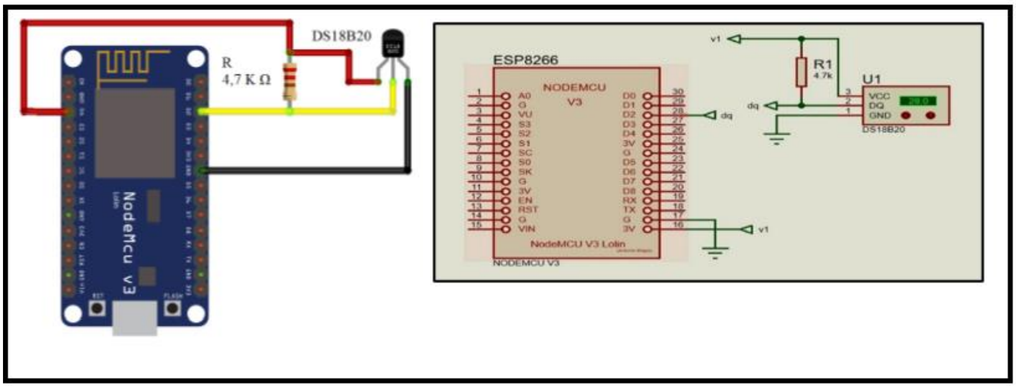
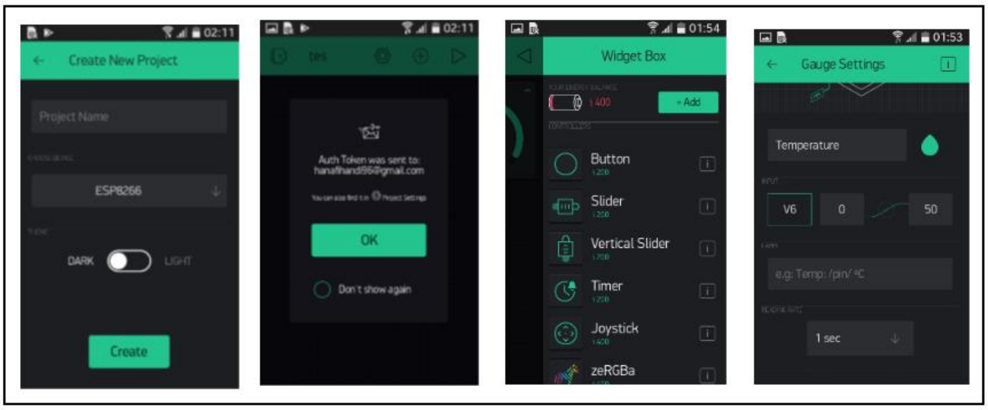


Fig. 4. NodeMCU pin connection with DS18B20 sensor.

The hardware created on this project served to transmit the data obtained by the sensor to Blynk. The NodeMCU ESP8266 module processed the data obtained by the DS18B20 temperature sensor, and then the sensor data was sent to the Blynk Application.

3.4 Blynk installations



(a) Create new project (b) auth token (c) Widget Box (d) Gauge Temperature

Fig. 5. Blynk installations.

Blynk design consists of 4 stages, namely:
(a) Create a New Project to create a new project
(b) Auth Token to send Blynk token authentication to email to apply to program code;
(c) Widget boxes serve to create gauges to be used;
(d) Gauge temperature to regulate the appearance of the temperature value;

4 Result and discussion

Fig. 6. the environment when the research was conducted.

The process of designing tools was started from field studies first. Field studies served to determine the type of sensor and the number of material needs needed to make the circuit. The next process was to make tools. Tool creation was begun by stringing components in the form of a series of prototypes on the project board, then coding programming and designing the interface display. After all was done, it continued with the test of the circuit whether it could run under the coding that would be given and whether the interface display on android smartphones could already display the desired results. After all these processes were running successfully, it continued with socialization to electric steam power plant operators to understand how to work, use, and troubleshoot this tool.

The image below is the final result of the project from the appearance of the Blynk application user interface that has been made on android smartphones.

4.1 Blynk testing result

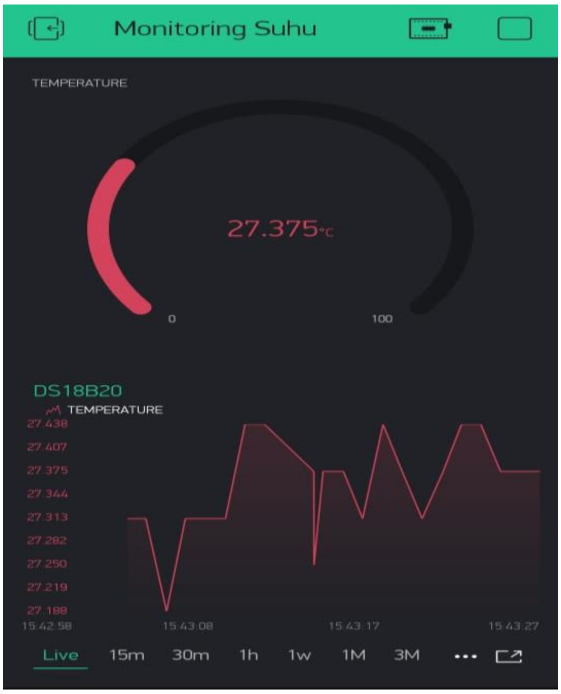


Fig. 7. Blynk application user interface as sensor data monitoring interface.

The **Figure 7** above displays sensor implementation data on Blynk application devices. Blynk application was used as temperature sensor monitoring remotely

4.2 Comparrasion of temperature data

The data below compares the amount of data recorded between the manual method (Thermo gun) and the Real-Time Method using the Blynk Application from the data 7 measurement in 7 hours. It can be said that this prototype system was feasible to use because it could retrieve data in real time. The data were also quite good, worthy of comparison with industrial standard thermo guns.

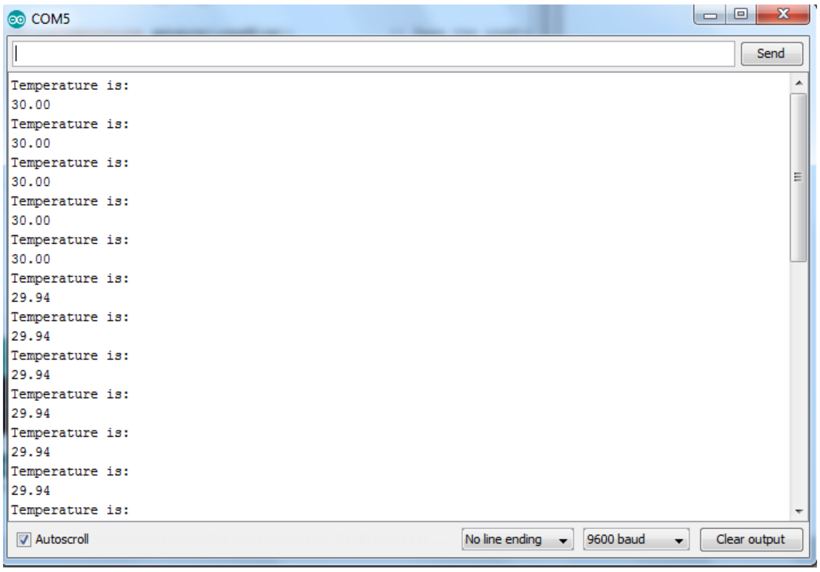


Fig. 8. Monitoring from the serial monitor.

Table 1. Comparison of temperature data.

Measurement	Sensor DSB 18B20 C	Thermo gun C	Differences C
1	28.13	29	0.87
2	28.5	29.3	0.8
3	28.9	29.5	0.6
4	28.8	29.7	0.9
5	28.8	29.5	0.7
6	28.8	29.5	0.7
7	29	29.5	0.5
	Mean differences		0.724

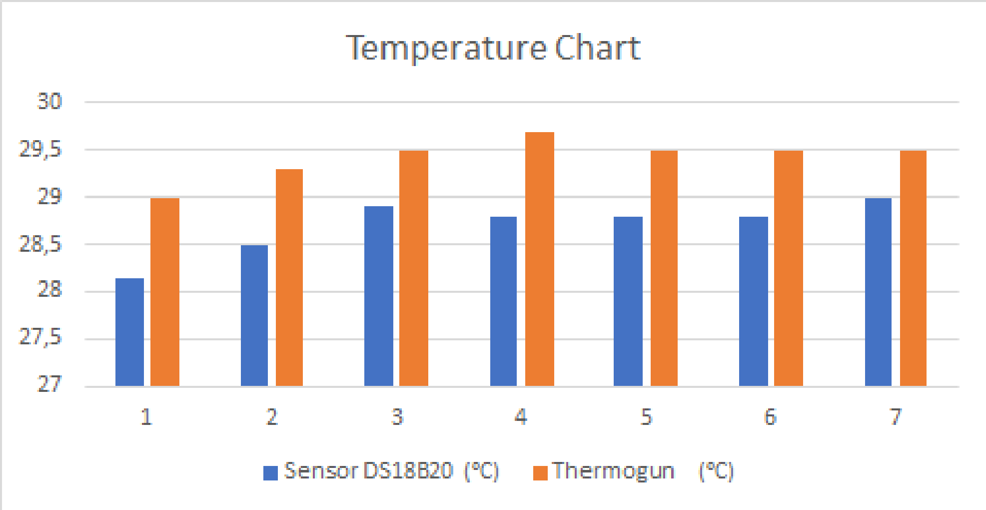


Fig. 9. Comparison of temperature data chart.

5. Conclusion & suggestion

This research resulted in a prototype of monitoring the water temperature downstream of the canal easily and continuously based on IoT and contributed to maintaining the environment around the Steam power plant. The result of monitoring temperature sent real data compared to the thermo gun.

It is suggested to integrate Blynk with the Excel app in making a data logger.

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