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Design of FD fan bearing temperature monitoring system in steam power plant based on Arduino and Thingspeak

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Abstract
Temperatures of the FD Fan bearings in steam power plants can be monitored either remotely from the Control Room or by directly observing them in the field. The notion of utilizing Thingspeak as a foundation for an application has developed into a means of facilitating communication and collaboration between individuals and machinery. This is done to enhance the effectiveness and efficiency of the current situation. This research project aims to design a monitoring system that utilizes Arduino, an MLX90614 infrared sensor, and a wifi module. The objective of this system is to facilitate the monitoring of the temperature of the FD Fan in a steam power plant. This is achieved by utilizing a laptop computer that is connected to the internet network and operates on the Thingspeak platform. The approach employed involves data processing and analysis, utilizing the findings from field research as well as existing literature and concepts. The equipment is placed on the bearing surface, and the sensor measurements are acquired within a duration of 18 minutes and 11 seconds. Data is transmitted to the laptop device at regular intervals of 16 seconds. Therefore, a grand total of sixty data points were transferred, an average value for the temperature of the bearing was measured, and the findings were sent to the laptop. By harnessing the power of the internet network, the findings indicate that the system can effectively transfer data to the laptop instantaneously.

Keywords: Arduino, sensor infrared MLX90614, Thingspeak

Introduction
A steam power plant is an electricity-generating facility that harnesses the kinetic energy of steam to produce electrical energy (Suroso, 2019). This plant utilizes a range of auxiliary equipment, including the FD Fan, which operates continuously. Therefore, it is imperative to conduct regular monitoring to maintain the proper functioning of the auxiliary equipment. The monitoring process is conducted by field operators who manually record data using stationary equipment such as paper and pencils. Consequently, the acquisition of information is time-consuming (Anwar, 2015) [1]. In light of this observation, the researchers intend to modify the operator's monitoring equipment by transitioning from stationary equipment to Thingspeak-based monitoring. This modification will enable swift connectivity to the control room, allowing it to function as a receiver and storage unit for monitoring data collected in the field. Thingspeak is an open source Internet of Things (IOT) application platform and API (Application Programming Interface) that enables the storage and retrieval of data from sensors using the HTTP protocol over the Internet. This technology is becoming more advanced with the development of information technology (Samsugi, 2017).
A significant portion of this research has been conducted utilizing Thingspeak. In a prior study by Akbar and colleagues (2019), reservoir water levels were monitored using Thingspeak. Dwi, 2015 Utilizing an online monitoring system to track and assess the quality of lake water. (Anwar, 2015) [1] Developing a microcontroller-driven system for managing water quality, which includes an automated sampling feature. (Sukamto, 2016) Comparing water quality with web-based PDAM monitoring. (Palimbuga, 2017) employs a Wireless Wifi IP network for the purpose of monitoring acidity. Researchers also aim to utilize this application for the purpose of detecting the bearing temperature of FD fans in steam power plants, where it is crucial to continuously monitor this equipment.

Research Method
Research Type
The research employed a quantitative methodology, in which existing data was transformed into processed data utilizing software.

Research Location and Time
This research was carried out at PLTU PT. Puncak Jaya Power, located in Amampare, Mimika Regency, Central Papua.

Research Tools
The tools utilized in the data collection and processing phase of this final project encompass Safety Equipment (PPE), Stationery (ATK), Work tools (screwdriver, cutting pliers, cutter, multimeter, soldering iron, etc.), LOLIN Wemos D1 R1 Board, Mlx90614 temperature sensor, 9 volt battery, plastic box, laptop, and smartphone.

Data Sources
The data sources used in this research are primary and secondary data sources. Primary data was obtained through direct interviews with internal parties at PLTU PT. Puncak Jaya Power and observing PLTU PT Puncak Jaya Power activities. Furthermore, the secondary data is acquired by means of paperwork, specifically archive data owned by PLTU PT. Puncak Jaya Power, as well as middleman and online media sources.

Data Collection Techniques and Instruments
Data collection techniques in this research used several methods, namely literature study, interviews, observation and documentation. Data collection techniques through

literature studies involve collecting, evaluating, analyzing and synthesizing information from relevant literature sources to support certain research or analysis. Furthermore, interviews were conducted involving several employees of PLTU PT. Puncak Jaya Power, especially in the instrumentation and control sections. In the data observation process, researchers directly observe activities at the research site/location and follow every activity related to PLTU operations. Finally, documentation refers to data that is stored in the form of archives and documents, which may be easily accessed.

Data Analysis Technique

The present stage of our work involves processing the data collected from field research. The data is analyzed in accordance with the existing literature and theories.

Findings and Discussion

The very first stage of this study involves procuring the primary hardware equipment, which will thereafter be positioned directly on the bearing surface area of the FD Fan. Following that is the process of software creation, followed by tool testing, and ultimately data collecting. The testing and data collection process will be contingent upon the quality and reliability of the internet network. The primary tool installed on the FD Fan equipment will collect bearing temperature data and transmit it automatically and instantaneously to laptops and cellphones via the internet network.

Assembling Hardware

The main tool used in this research is a box in which electronic components will be assembled, namely: LOLIN Wemos module (D1 R1), MLX90614 infrared sensor, breadboard, 9V battery, switch. The scheme used to assemble the components is as shown in the image below.

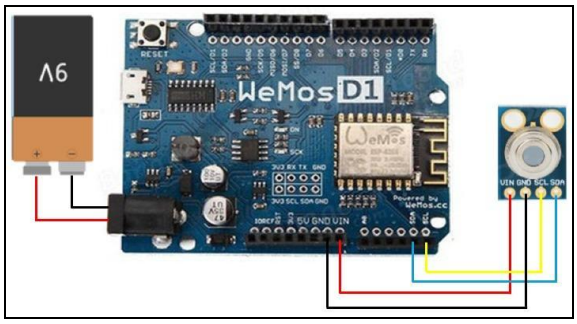

Fig 1: Main equipment circuit schematic

Table 1: Arrangement of the Wemos D1 R1 Circuit to the MLX90614 Infrared Sensor

Wemos D1	Sensor infrared MLX90614
Pin Gnd	Pin GND
Pin Vin	Pin VIN
Pin SCA	Pin SCA
Pin SDL	Pin SDL

Table 2: Arrangement of battery circuit for Wemos D1 R1

Battery 9V	Wemos D1
Pin -	Soket DC Input (-)

Table 3: Arranging the battery circuit to the Switch

Battery 9V	Saklar
Pin +	Saklar

Table 4: Arrangement of the Wemos D1 R1 circuit to the switch

Wemos D1	Saklar
Soket DC Input (+)	Saklar

Figure 2. below shows the components that have been assembled in the box that has been prepared.

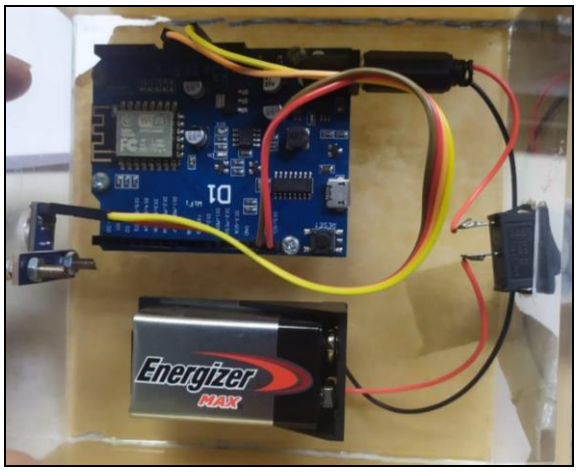

Fig 2: Main tool that has been completed assembled

The box is then placed on the FD Fan bearing. The position of the box installed on the FD Fan bearing can be seen in Figure 3.

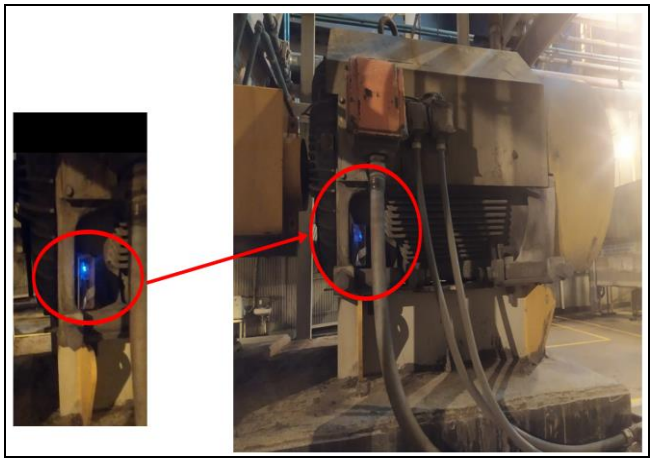

Fig 3: Main tool that has been installed on the FD Fan Bearing

Software Arrangement

In software design, three main tasks are performed. Firstly, a cloud server is created on ThingSpeak to receive real-time data from sensors installed on the FD Fan. This data is then displayed in graphical form. Secondly, the Arduino and LOLIN WEMOS (D1 R1) are programmed.

Create a channel on Thingspeak

Before establishing a channel on Thingspeak, it is necessary to first create an account on the website. The following presents the channel that has been established.

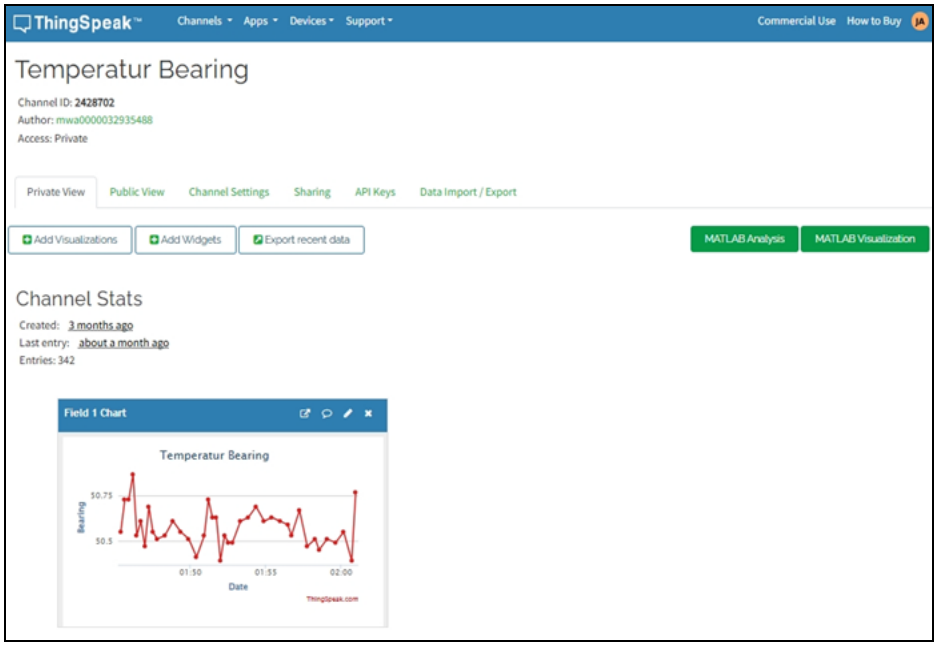

Fig 4: Display the channel page that has been created

This channel page will display the results of the FD Fan temperature sensor readings in real time, in graphic form and also in numerical form. Through this channel, an API (Application Programming Interface) has been generated automatically for each channel that has been created. This AP code will later be used in LOLIN Wemos D1 R1 programming, so that the reading results from the temperature sensor can be received on Thingspeak to be displayed in the form of graphs and numbers.

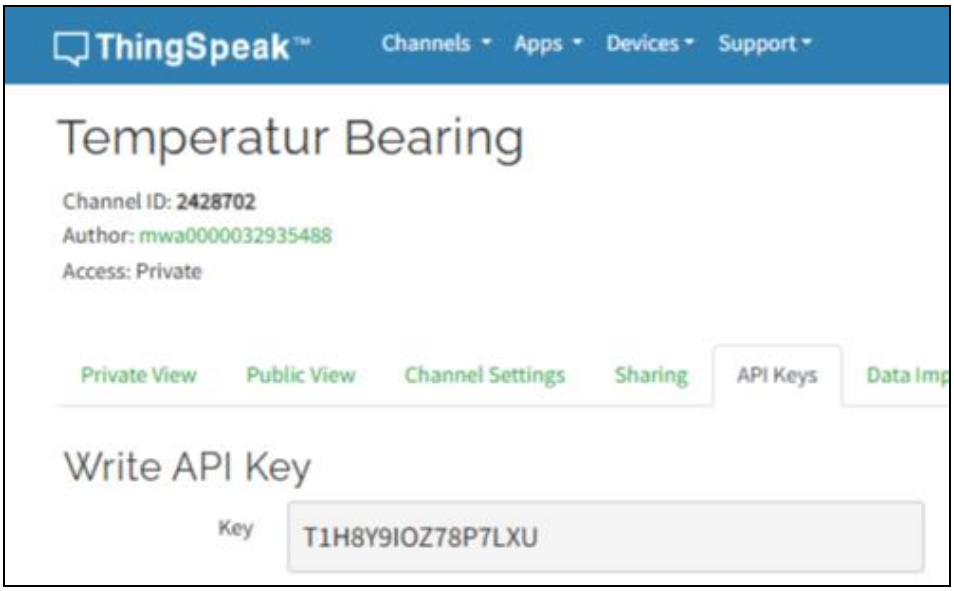

Fig 5: API key number of the channel that has been created

The image above is the API code on the channel page on Thingspeak. The API code generated by Thingspeak will be different for each channel created.

Arduino software programming and installing LOLIN Wemos D1 R1

In principle, the Arduino software creates programs and forwards them to LOLIN (Wemos) D1 R1, and then LOLIN (Wemos) D1 R1 will send the data to Thingspeak. The time interval for sending data is every 16 seconds. Researchers use Arduino software as a programming medium.

Arduino IDE software can be downloaded from the official Arduino Website at:http://arduino.esp8266.com/stable/package_esp8266com index.jason.

Things that need to be considered when creating a program for (LOLIN Wemos (D1 R1) is that SSID (Service Set Identifier) information and WIFI password are needed so that LOLIN (Wemos) D1 R1 can connect to the internet network so that it can send data to Thingspeak, while an API key is needed to determine the data that will be sent to the channel address that was previously created on Thingspeak.

In Arduino programming, what you can know and understand is that the MLX90614 infrared sensor is connected directly to LOLIN (Wemos) D1 R1 according to the scheme in Figure 3.1.1. The MLX90614 infrared sensor sends data on the distance between the sensor and the FD Fan bearing surface, while the data needed in this research is the bearing temperature on the FD Fan.

Upload the program for Arduino to LOLIN (Wemos) D1 R1

In this case, the program that is uploaded is the program on the Arduino to LOLIN Wemos D1 R1, after completion, continues by connecting the laptop and LOLIN (Wemos) D1 R1. When the data/communication cable is connected between the Laptop- LOLIN (Wemos) D1 R1, LOLIN (Wemos) D1 R1 uses the COM3 port.

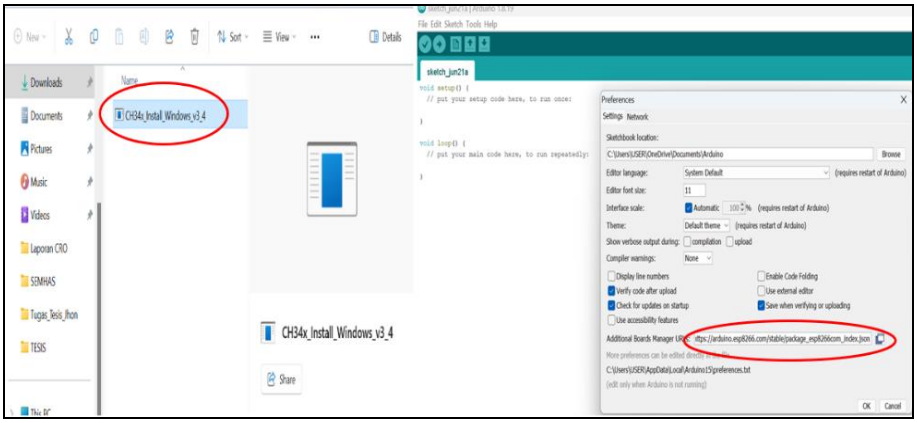

Fig 6: Selecting USB port channel on Laptop for LOLIN Wemos D1 R1

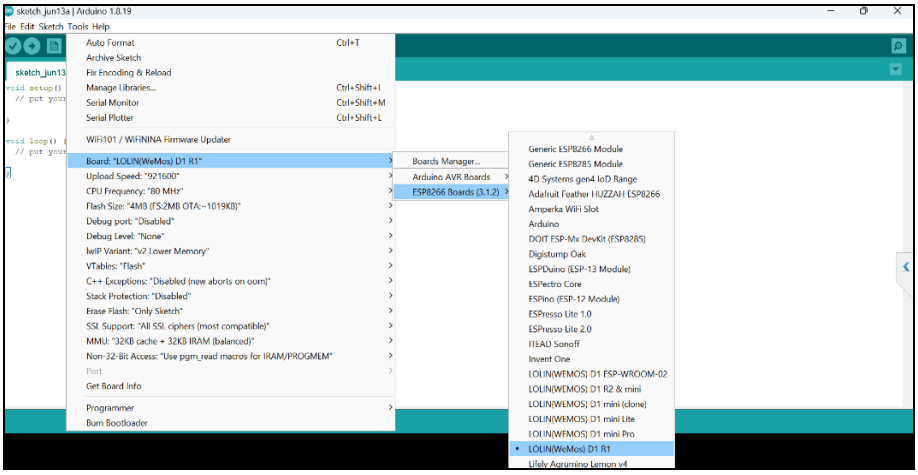

Fig 7: Board selection for LOLIN Wemos D1 R1 in Arduino software

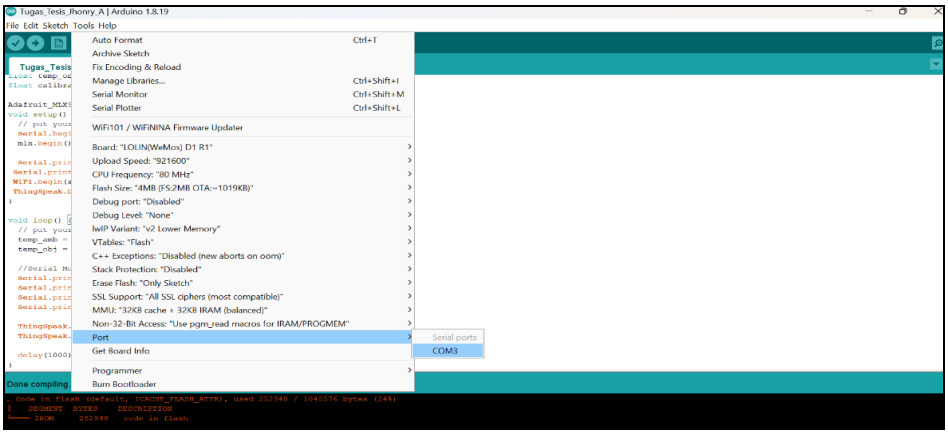

Fig 8: Port selection for LOLIN Wemos D1 R1 in Arduino software

Once the communication configuration process between the Laptop and LOLIN (Wemos) D1 R1 is complete and successful, you may proceed with the software upload process. When transferring a program from a laptop to LOLIN (Wemos) D1 R1, the first step is the compilation procedure. Upon successful compilation, the application will proceed with the automatic uploading procedure until completion, indicated by the display of the statement "done compiling".

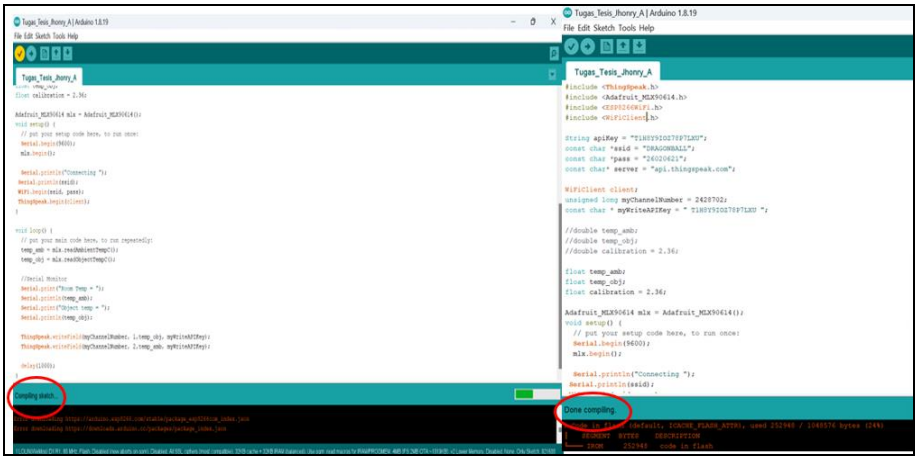

Fig 9: The procedure of compiling and uploading a program successfully

After the program has been uploaded to Arduino and the LOLIN Wemos D1 R1 board is ready, which is the final stage of data collection preparation, then the bearing temperature data collection can be carried out. Equipment that has been installed on the FD Fan, when turned on/activated, the sensor will send data online in real time to the Thingspeak cloud server automatically by utilizing the existing internet/Wifi network. So that bearing temperature data and graphs can be seen on a laptop/smartphone.

As explained, the time interval for each data transmission is 16 seconds (from the sensor to the Thingspeak server). Researchers took data samples for 18 minutes and 11 seconds, or as many as 60 data were sent as analysis material.

Looking at the data displayed from the test results, it shows that all the equipment used can function properly and most importantly that the bearing temperature data can be connected to the internet/wifi network so that the data can be accessed online in real time, from anywhere via smartphone without distance limitations. /time. The average bearing temperature value based on test data is 50.550C.

Conclusion

Based on the conducted research and the defined problem, it can be concluded that the sensor collects bearing temperature data for a duration of 18 minutes and 11 seconds. The data collection occurs every 16 seconds, resulting in a total of 60 data points sent to the smartphone. The average temperature value of the bearings is 50.55°C. A temperature monitoring system for the fan bearings at PLTU PT. Puncak Jaya Power, which does not have any constraints in terms of distance and time, can be developed using Arduino LOLIN (Wemos) D1 R1 and Thingspeak. This system utilizes the internet network. The temperature of the FD fan bearing at PLTU PT. Puncak Jaya Power may be continuously monitored in real time from any location and at any time using a smartphone connected to a thingspeak-based system. This system utilizes an Arduino LOLIN (Wemos) D1 R1 and an Infrared Sensor MLX90614, eliminating any constraints related to distance and time.

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