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Measurement Of Electrical Parameters On Iot-Based Main Generators For Safe Operational Feasibility

Herru Prastyo
Computer Engineering Major, NSC Polytechnic, Indonesia
herruez@gmail.com

Slamet Winardi
Faculty of Computer Science, Narotama University, Indonesia
slamet.winardi@narotama.ac.id

Arief Budijanto
Computer Engineering Major, NSC Polytechnic, Indonesia
ariefbdj212@gmail.com

ABSTRACT
The generator is the main source of electricity on the ship which will power all activities on the ship. With an electricity source supplied by a generator, human work will become lighter because of the help of electrical energy. In order for the generator to work well, it requires maintenance and must always be well controlled, so that the parameters produced by the generator must always be maintained by monitoring these parameters automatically using the ESP32 microcontroller. The parameters measured are current, voltage, power, frequency, work factor, KWh, RPM, temperature and vibration. By measuring the magnitude of these parameters, they can later be used as variables for maintenance and repair of the generator. The sensor used to measure the electrical parameters is the PZEM004t module because it can measure all generator electrical quantities, while temperature uses the DS18B20 sensor and vibration uses the SW420 sensor module. Then to measure the RPM using a potentiometer. The measurement results are displayed on a smartphone screen on the bridge using Internet of Things (IoT) technology sent from the engine room.

Keywords: Ship Engine Cooling, Fuzzy Logic, ESP32, Water Flow Control, Temperature Control

1. Introduction

The generator functions as the primary power source on a ship, capable of automatic operation and providing sufficient power for all electrical systems. In the event of failure, it automatically switches to the auxiliary generator. Therefore, all parameters of the generator must be adequate to anticipate workloads that require electricity on the ship. Human labor is facilitated by electrically powered equipment, such as ship lighting and navigation systems, which operate according to their designated functions. Electrical energy is crucial on ships as it powers equipment requiring electricity. In large passenger ships, multiple sub-distributions of electrical power are necessary, with a load center switchboard provided for distribution.(Radan, n.d.)

To ensure continuous monitoring of the generator's electrical parameters onboard, an IoT technology solution is employed. This tool measures and displays the generator's electrical parameters in real-time, enabling efficient monitoring of electricity demand. The distribution and monitoring of electricity onboard are managed through Android displays. The ship's electricity supply from the generator is constantly monitored, and in cases where the main generator is insufficient or experiences issues, it is automatically supported or replaced by the auxiliary.(Saputra et al., 2021)

1.1 Generator

The generator on the ship has the main function of supplying the ship's electrical power needs. Electrical power is used to drive equipment on ships, such as engine rooms and machines on deck, ship communication and navigation systems, lighting, ventilation, kitchen equipment, sanitary systems, alarms, cold storage, fire detection systems, and other machines. The ship's power is generated using the main propulsion and alternator working together. For this, alternating current generators are used

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on ships. Generators work on the principle that when the magnetic field around a conductor varies, a current is induced in the conductor. The generator consists of a set of stationary conductors wound in coils on an iron core. This is known as the stator. Rotating magnets called rotating rotors inside the stator produce a magnetic field. This field cuts through the conductor, producing an induced EMF or electro-magnetic force when the mechanical input causes the rotor to rotate.(Ma'arif, 2011)

Figure 1. Main Generator(Radan, 2008)

Power Distributed on board the ship needs to be supplied efficiently throughout the ship. For this the ship's power distribution system is used. Ship distribution systems consist of different components for distribution and safe operation of the system. Consist of:(Sørfonn, 2007)

- Ship generator consisting of main drive and alternator
- The main switchboard which is a metal enclosure that takes power from the diesel generator and supplies it to different engines.
- Bus Bars that act as carriers and allow the transfer of loads from one point to another. Circuit breakers that function as switches and are in unsafe conditions can be tripped to avoid damage and accidents. Fuses as a safety device for machines.
- Transformer to increase or decrease the voltage. When supply is to be given to a lighting system, a step down transformer is used in the distribution system.
- In power distribution systems, the system working voltage is usually 440v.
- There are several large installations where the voltage reaches 6600v.
- Power is supplied through circuit breakers to large auxiliary machines at high voltage.
- For smaller supplies fuses and miniature circuit breakers are used.
- The distribution system is three-wire and can be insulated or neutrally grounded.
- Isolated systems are preferred over grounded systems because during an earth fault, important machinery such as the steering gear can be lost.

In the event of a failure of the main power generation system on the ship, an emergency power system or standby system is also in place. An emergency power supply ensures that critical engines and systems continue to operate the vessel. Emergency power can be supplied by batteries or an emergency generator or even both systems can be used. The emergency power supply rating should be such that it provides supply to critical systems of the ship such as;(Gunawan & Hartanto, 2018)

a) Steering wheel system
b) Emergency hull and fire p/p
c) Watertight door.
d) Fire extinguishing system.
e) Ship navigation lights and emergency lights.
f) Communication and alarm system.

The emergency generator is usually located outside the ship's engine room. This is done primarily to avoid emergency situations where access to the engine room is not possible. A switchboard in the emergency generator room supplies power to various critical machines.

2. Reasearch Method

2.1 Hardware Design

The first stage is to create a hardware design in the form of a block diagram, then explain in each block diagram the function and how each block works.

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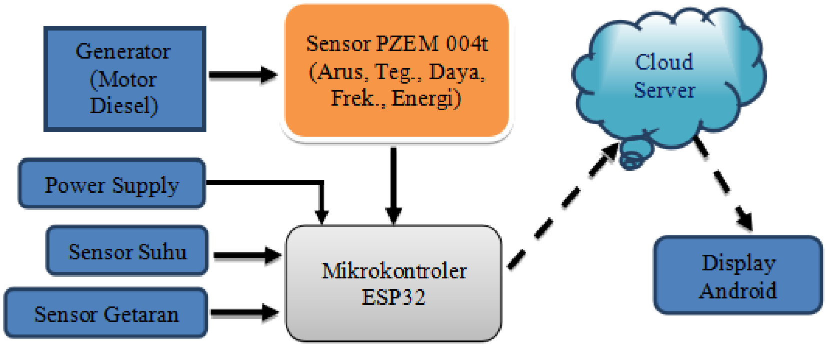

Figure 2. System Block Diagram

Function of each Block:

- Generator (Diesel Engine)
  It serves as the electricity generating system on a ship, with parameters monitored to ensure safe operation. These parameters include voltage, load current, power, frequency, and energy consumption.
- PZEM 004t sensor
  The PZEM-004T module is a multifunctional sensor module which functions to measure power, voltage, current and energy contained in electric current. This module is equipped with integrated voltage and current (CT) sensors. In its use, this tool is specifically intended for indoor use and the installed load must not exceed the specified power.
- ESP32 microcontroller
  This microcontroller will read data from the PZEM sensor, then process the data and then send the data to the cloud database. If there is data that does not match the generator specifications whose parameters are measured, this microcontroller will send a notification to the smartphone via the cloud server.
- Firebase Cloud Server
  The data sent by the microcontroller will be stored in a cloud database, namely Firebase. Data will be stored in tag variables to be used by smartphones as information media.
- Android Smartphones
  To display generator parameter data as information used by the user to determine the performance of the generator, as well as providing notification information if the measured generator parameters do not match the specifications of the diesel motor generator.

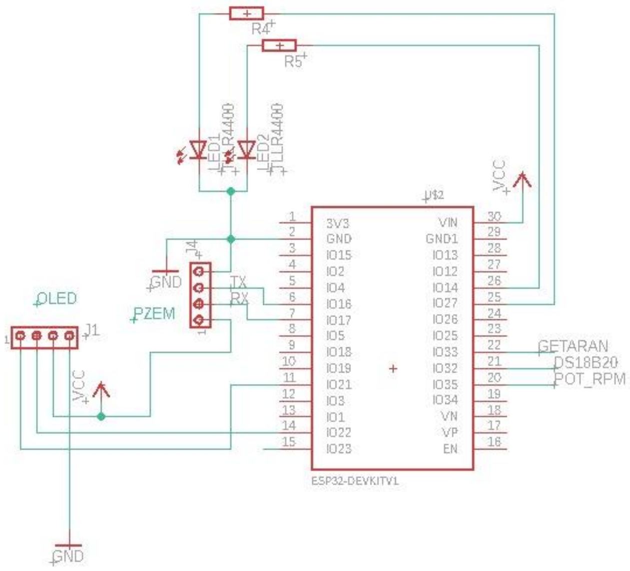

Figure 3. Schematic Diagram System

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Figure 4. prototype of ship generator parameter monitoring tool

3. Result and Discussion

The measurement results in the first 1 hour and the second 1 hour can be seen in table 1 and table 2.

Table 1. First 1 Hour Tool Test Results

minute	Voltage (volt)	Load Power (watt)	Power Factor	Frequency (Hz)	Current (A)	KWh	RPM	Vibration (Ms)	Temperature (ºC)
1	233,3	53,4	0,98	50	0,23	0,01	1500	0.78	25.
15	233,3	53,4	0,98	50	0,23	0,02	1500	0.78	26
30	233,3	53,4	0,98	50	0,23	0,03	1500	0.78	27.9
45	233,3	53,4	0,98	50	0,23	0,04	1500	0.78	30.1
60	233,3	53,4	0,98	50	0,23	0,05	1500	0.78	31.2

Table 2. Results of Testing Tool 1 for the First Second Hour

minute	Voltage (volt)	Load Power (watt)	Power Factor	Frequency (Hz)	Current (A)	KWh	RPM	Vibration (Ms)	Temperature (ºC)
75	233,3	53,4	0,98	50	0,23	0,07	1500	0.78	32
90	233,3	53,4	0,98	50	0,23	0,08	1500	0.78	33
115	233,3	53,4	0,98	50	0,23	0,09	1500	0.78	34
120	233,3	53,4	0,98	50	0,23	0,12	1500	0.78	34.5

4. Conclusion

The conclusions from the research starting from designing and testing the tool are as follows:

1. The tool can work according to its purpose, namely being able to monitor the results of measuring generator parameters, namely voltage, power, KWh, current, power factor, temperature, RPM and vibration.

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2. After testing for 2 hours the electrical parameters were maintained constant, except for the temperature parameter but it was still within the allowable range.
3. These parameters can be monitored via an Android mobile phone, making it easier for operators to see the condition of the generator anywhere and can quickly identify faults, before serious generator damage occurs.

Reference

Gunawan, S., & Hartanto, A. T. (2018). Analisa Kegagalan Sinkron Pada Paralel Dua Generator. *Jurnal Kajian Teknik Elektro*, *3*(1), Article 1. https://doi.org/10.52447/jkte.v3i1.1058

Ma'arif, F. P. A. (2011). Simulasi Paralel Generator Secara Otomatis pada Kapal STAR-50 BSBC 50,000 DWT dengan Menggunakan Pendekatan Software LabVIEW 8.5. *Tugas Akhir*.

Radan, D. (n.d.). *Control Of Marine Electrical Power System*.

Radan, D. (2008). *Integrated control of marine electrical power systems*. https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/231176

Saputra, B., Winardi, S., & Nugroho, A. (2021). Rancang Bangun Bangun Alat Meteran Air Pintar Berbasis IoT Sebagai Penunjang Layanan Distribusi PDAM. *Jurnal RESISTOR (Rekayasa Sistem Komputer)*, *4*(1), 1–10. https://doi.org/10.31598/jurnalresistor.v4i1.588

Sørfonn, I. (2007). *Power Management Control of Electrical Propulsion Systems*.