A Review: Design and Build Damage Detection Equipment on Sensors and Power Supply Automatic Rain Gauge (ARG) With Long Short Term Memory Integrated

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Abstract

The Meteorology, Climatology, and Geophysics Agency (BMKG) technicians have successfully developed automatic rain measuring devices. This tool is called Automatic Rain Gauge - BMKG (ARG-BMKG). The existence of this instrument can replace conventional rain measuring observation systems or public rain stations in Indonesia. ARG – BMKG consists of a tipping bucket sensor, solar panels, GPRS modem, dry battery, and data logger. This repeated operation causes sensor measurement errors due to damage to the sensor due to the sensor voltage supply not meeting specifications, resulting in inaccurate data sent. Predicting sensor damage can be done with predictive maintenance. The results of field tests in previous studies showed that the system could operate properly where the device could measure the voltage of each sensor and send data to the database A sensor damage prediction model was designed and implemented using long-short term memory (LSTM) by generating root mean square error (rmse). The system can provide damage prediction information on the sensor, and the power supply is displayed through the website properly.

Keywords: ARG, LSTM, Sensors and Power Supply

1. Introduction

The Meteorology, Climatology, and Geophysics Agency (BMKG) is an agency that has the main task and function of observing weather, climate, and geophysical phenomena in Indonesia. One of the parameters observed by BMKG is rainfall whose observation data is very useful for the purposes of various fields [1]. To measure the intensity of rain, a tool called a rain steamer is needed. BMKG itself has two types of rain gauges, namely conventional and automatic rain gauges. Automatic rain measuring devices have been successfully developed by technicians of the Meteorology, Climatology and Geophysics Agency (BMKG) [1] This tool is called Automatic Rain Gauge - BMKG (ARG-BMKG). The existence of this instrument can replace conventional rain measuring observation systems or public rain stations in Indonesia. ARG – BMKG consists of a tipping bucket sensor, solar panels, GPRS modem, dry battery, and datalogger. ARG – BMKG operates daily and produces rain intensity variation values of 40 mm/hour for moderate rain and 250 mm/hour for heavy rainfall [1].

This repeated operation causes sensor measurement errors due to damage to the sensor due to the sensor voltage supply not meeting specifications, resulting in inaccurate data sent. To prevent the occurrence of damage, repairs to the equipment can be carried out [2]. Effective repair can be done by knowing when a tool failure will occur. Such repairs can be done by anticipating sensor damage. Predicting sensor damage can be done with predictive maintenance. Predictive maintenance is a repair with the step of calculating the beginning of damage to the equipment. Sensor fault prediction operation on ARG – BMKG uses historical data to predict data anomalies [3].

This study focuses on the use of predictive maintenance as a basis for predicting damage to the tipping bucket sensor (reed switch) and ARG - BMKG power supply. The input data used is the input voltage value of the reed switch and power supply on the ARG - BMKG datalogger [4]. The voltage value is then analyzed using the Long Short - Term Memory (LSTM) method to get a prediction of the
voltage and damage conditions on the sensor which then the analysis results are displayed via the web with notifications if anomalies occur in the data\cite{2}. This prediction system will make it easier for technicians to immediately carry out equipment maintenance so that the data produced remains accurate.

2. Research Methods

Based on previous studies that have been carried out for the manufacture of predictive maintenance tools ARG – BMKG and other studies that have a relationship with predictive maintenance, the research that will be carried out by the author will be discussed below.

![Figure 1. Design system](image)

Input sensor damage prediction system is a rated voltage value on the reed switch sensor and ARG power supply voltage. The system process is divided into four stages, namely processing on arduino mega 2560 microcontrollers, databases, LSTM processing and IoT. The output of the system processing results is in the form of sensor conditions in the next 30 minutes and its voltage graph displayed on the system web.
3. Results And Discussion

The results of field testing in previous studies show that the system can operate properly where the tool can measure the voltage of each sensor and send data to the database and researchers can see the display of monitoring pages, graphs, and predictions of sensor damage through the website. The results of field testing using a comparison method with real field conditions, where the results of system testing for predicting sensor damage and power supply produce predictive values with a small average error. The working principle of the system begins with the voltage sensor detecting the voltage on the reed switch sensor and the input voltage on the ARG datalogger. The sensor output is then processed using arduino mega 2560 to find out the rated voltage value on each sensor. Arduino mega 2560 processes voltage data by adding a timing system based on the input of the RTC DS3231 module. The voltage data from the microcontroller processing is stored in the system database using the nodemcu esp8266 wifi module. The data stored in the database is used as input in modeling the sensor damage prediction system. Sensor damage prediction system modeling uses a python programming language with the recurrent neural network long short term memory method to predict voltage values in the next 30 minutes. The data stored in the database is used as input in modeling the sensor damage prediction system [2].
4. Conclusions

Previous research has shown the application of the LSTM algorithm as a predictive model for damage to sensors and power supplies. A sensor damage prediction model designed and implemented using long short-term memory (LSTM) by generating root mean square error (rmse). The system can provide damage prediction information on the sensor, and the power supply is displayed through the website properly.

References

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