**Journal of Artificial Intelligence and Engineering Applications**

*Website: https://ioinformatic.org/*

***15th February 2023. Vol. 2. No. 2***

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

**Nosagiga Widiansyah[1], Rista Hernandi Virgianto[2], Hariyanto[3], Marzuki Sinambela[4*]**

[1,3]Instrumentation Study Program, STMKG
[2]Climatology Study Program, STMKG
[4]Geophysics Study Program, STMKG, Indonesia
[4]Department of Instrumentasi MKG,
Sekolah Tinggi Meteorologi, Klimatologi dan Geofisika, Indonesia,
Jl. Perhubungan I No.5 Pondok Betung, Bintaro, Kec. Pd. Aren, Kota Tangerang Selatan, Banten 15221.
sinambela.m@gmail.com

**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-sort 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

***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[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 maintennace*, the research that will be carried out by the author will be discussed below.

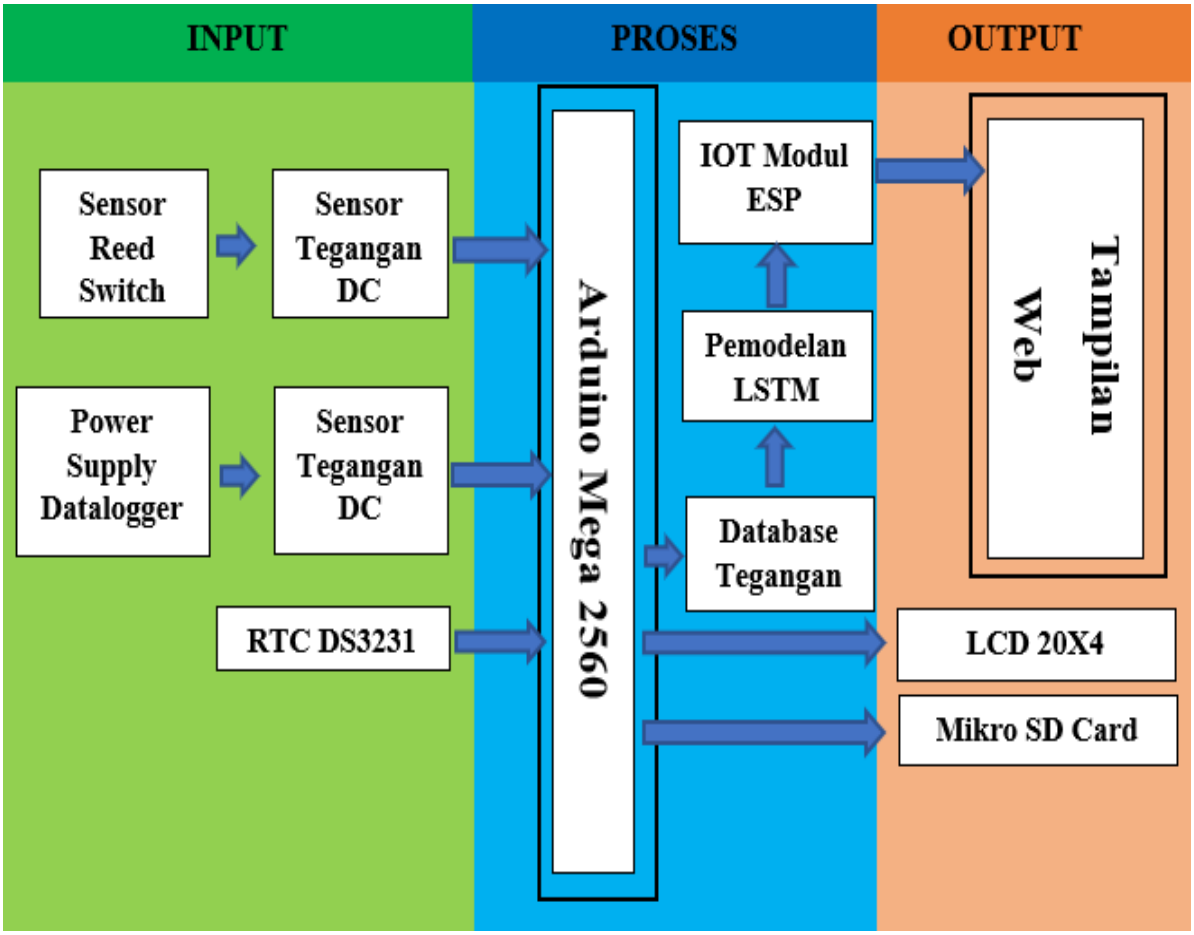


*Figure 1. Desain system*

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.

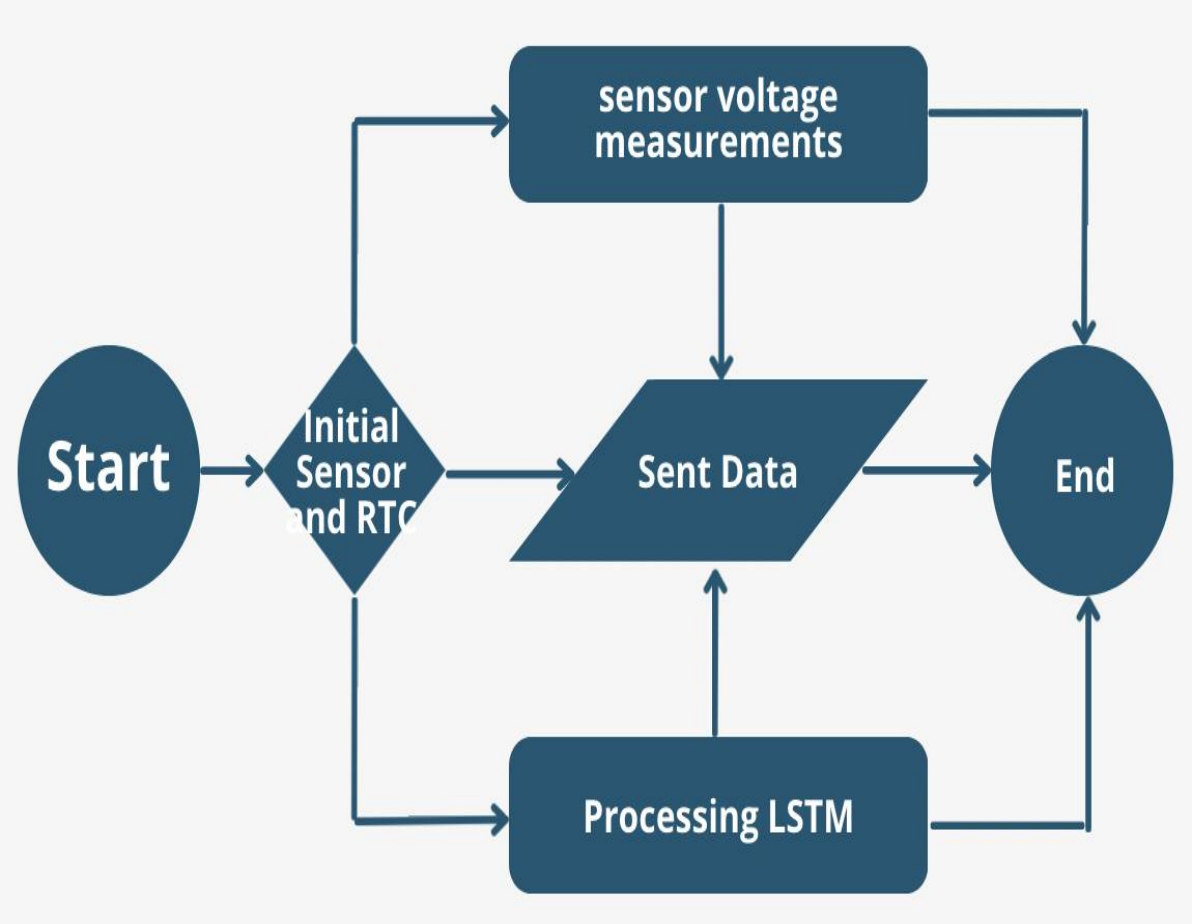


*Figure 2. Flow chart sistem*

## 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].

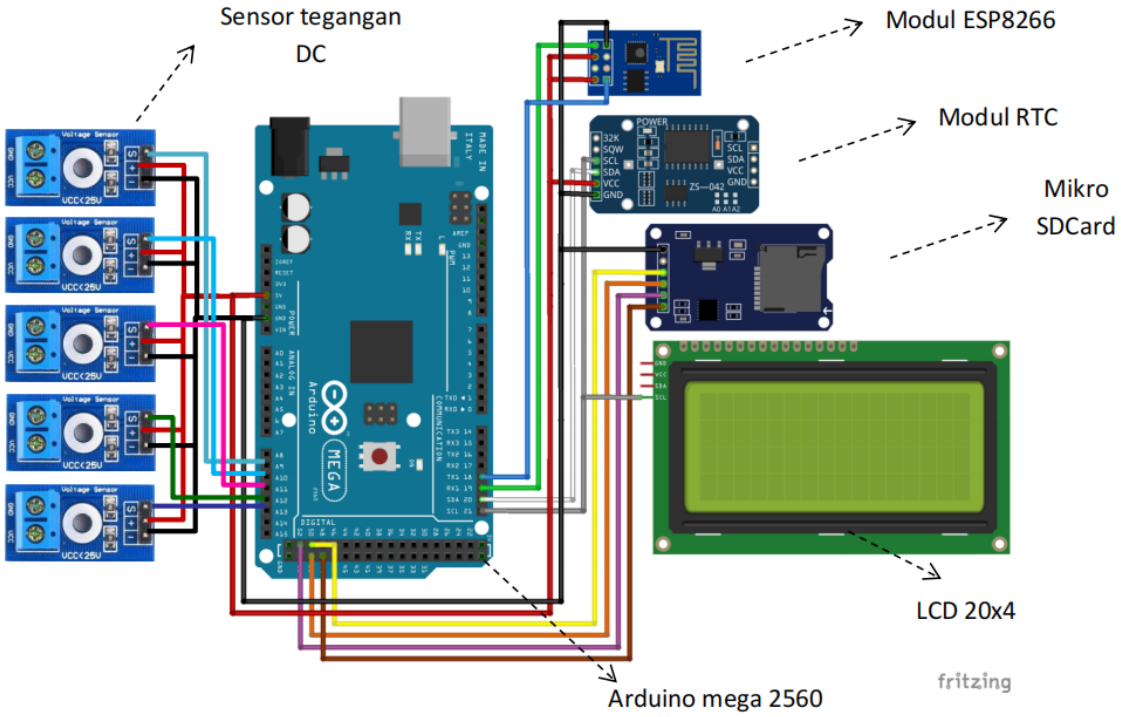


*Figure 3. Hadware Design*

## 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-sort 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

[1] I. Sofwan Lukito and J. Rimba, "AUTOMATIC RAIN GAUGE (ARG)."
[2] P. Rancang *et al.*, "Supply Automatic Weather Station Berbasis Internet of Things (Studi Kasus : Stasiun Klimatologi Malang) Development of Failure Detection Design for Temperature and Relative Humidity, Air Pressure, Solar Radiation Sensor, and Power Supply of Automatic Weather Station Based on Internet of Things (Case Study: Malang Climatology Station)."
[3] "SKRIPSI RANCANG BANGUN AWS MONITORING DEVICE UNTUK MENGECEK KUALITAS KELUARAN SENSOR BERBASIS INTERNET OF THINGS (IOT) DESIGN OF AWS MONITORING DEVICE TO CHECK THE QUALITY OF THE SENSOR OUTPUT BASED ON INTERNET OF THINGS (IOT)."
[4] "SKRIPSI SISTEM PREDICTIVE MAINTENANCE PADA ANEMOMETER DAN TIPPING BUCKET SECARA REAL TIME PREDICTIVE MAINTENANCE SYSTEM FOR ANEMOMETER AND TIPPING BUCKET IN REAL TIME."
[5] P. S. Brown Macheso and A. G Meela, "IoT Based Patient Health Monitoring using ESP8266 and Arduino," *International Journal of Computer Communication and Informatics*, vol. 3, no. 2, pp. 75–83, 2021, doi: 10.34256/ijcci2127.
[6] Y. Ding, H. Wu, and K. Zhou, "Design of Fault Prediction System for Electromechanical Sensor Equipment Based on Deep Learning," *Comput Intell Neurosci*, vol. 2022, 2022, doi: 10.1155/2022/3057167.
[7] K. M. Van'T Veen, T. P. A. Ferré, B. V. Iversen, and C. D. Børgesen, "Using machine learning to predict optimal electromagnetic induction instrument configurations for characterizing the shallow subsurface," *Hydrol Earth Syst Sci*, vol. 26, no. 1, pp. 55–70, Jan. 2022, doi: 10.5194/hess-26-55-2022.
[8] A. Khumaidi, R. Raafi, I. Permana Solihin, and J. Rs Fatmawati, "Pengujian Algoritma Long Short Term Memory untuk Prediksi Kualitas Udara dan Suhu Kota Bandung," *Jurnal Telematika*, vol. 15, no. 1.
[9] E. Supriyadi, "PREDIKSI PARAMETER CUACA MENGGUNAKAN DEEP LEARNING LONG-SHORT TERM MEMORY (LSTM) WEATHER PARAMETERS PREDICTION USING DEEP LEARNING LONG-SHORT TERM MEMORY (LSTM)." [Online]. Available: http://bmkgsoft.database.bmkg.go.id.
[10] M. Wildan Putra Aldi and A. Aditsania, "Analisis dan Implementasi Long Short Term Memory Neural Network untuk Prediksi Harga Bitcoin."
[11] Abimanyu, L. Katriani, and D. Darmawan, "Design of Automatic Rain Gauge Prototype (ARG) As An Early Warning Indicator for Cold Lava Flood Based on the Internet of Things (IoT)," in *Journal of Physics: Conference Series*, Apr. 2021, vol. 1805, no. 1. doi: 10.1088/1742-6596/1805/1/012013.
[12] S. Poornima and M. Pushpalatha, "Prediction of rainfall using intensified LSTM based recurrent Neural Network with Weighted Linear Units," *Atmosphere (Basel)*, vol. 10, no. 11, Nov. 2019, doi: 10.3390/atmos10110668.
[13] I. Sofwan Lukito and J. Rimba, "AUTOMATIC RAIN GAUGE (ARG)."
[14] A. A. Ningrum *et al.*, "ALGORITMA DEEP LEARNING-LSTM UNTUK MEMPREDIKSI UMUR TRANSFORMATOR," vol. 8, no. 3, pp. 539–548, 2021, doi: 10.25126/jtiik.202184587.

[15] W. Setyonegoro and R. Ramadhani, "SISTEM KEAMANAN PADA PENGIRIMAN DATA INFORMASI DINI TSUNAMI BERBASIS ANDROID PADA PIHAK BERWENANG SECARA NASIONAL-SECURITY SYSTEM IN SENDING TSUNAMI DATA EARLY INFORMASIRMATION B," 2016. [Online]. Available: https://www.researchgate.net/publication/305778439

[16] P. Instrumentasi *et al.*, "RANCANG BANGUN PROTOTYPE JARINGAN AUTOMATIC RAIN GAUGE (ARG) BERBASIS WEBSITE ACHMAD MAULANA RAFI*, BIMA TRI ARIYANTO, HAIRATUNISA, AGUS TRI SUTANTO," 2018.

[17] D. Cañiza, F. Mitjans, and O, "Remote Monitoring System of Automatic Rain Gauges using Machine-to-Machine application Evaluation of the effects of Climate Change on Air Transmission Lines, using PLS-CADD Software tools and Hierarchical Analytical Processes (AHP). View project Potential of Unconventional Hydrocarbons in the Paraguayan Chaco: Carandayty Sub-Basin Case View project Remote Monitoring System of Automatic Rain Gauges using Machine-to-Machine application," vol. 13, no. 1, pp. 4–13, doi: 10.9790/2834-1301010413.

[18] A. Khumaidi, R. Raafi, I. Permana Solihin, and J. Rs Fatmawati, "Pengujian Algoritma Long Short Term Memory untuk Prediksi Kualitas Udara dan Suhu Kota Bandung," *Jurnal Telematika*, vol. 15, no. 1.

[19] A. C. Achmad, "EVALUATION ON THE IMPLEMENTATION OF EARLY WARNING SYSTEM FOR DEBRIS FLOW IN MERAPI AREA (CASE STUDY AT BOYONG RIVER)," 2015.

[20] F. A. Adryan and K. W. Sastra, "Predictive Maintenance for Aircraft Engine Using Machine Learning: Trends and Challenges," *AVIA*, vol. 3, no. 1, Jul. 2021, doi: 10.47355/avia.v3i1.45.