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Data Logging Implementation on Web-Based Communication on Arduino Devices

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Abstract- Arduino is one of the microcontroller devices commonly used on the Internet of Things (IoT). This research designed and objectified web-based data logging system that aimed to record communication and sensor data in IoT devices, so it could monitor log data in IoT. Devices from this data logging system were created using arduino uno r3 with adding ethernet shield module and temperature sensor DHT 11 in IoT devices, there is an important parameter, that is date time as history in data logging system using an actual time. Website was functioned as a system for showing data from log data and could be monitored real-time. This system could record communication between arduino device and NTP server using internet network. Beside that, this system could record important parameters in the system such as IP source address, IP destination address, I address in each node, device time, and room temperature information. Parameters that had been recorded would be stored to the database, then would be showed in web data logging.

***Keywords*- Internet of Things, Data logging, Arduino, Website**

I. INTRODUCTION

In this modern era, a very rapid development is seen in the field of information technology and telecommunications which makes human work more structured and efficient. Nowadays, each other can communicate or communicate easily without having to meet in real time directly, as well as the work of humans who can only be controlled or directly monitored, now all can communicate without having to deal directly with using continuously connected internet connectivity always.

Along with the development of information technology today, one of the new trends has emerged but has been developed for a long time, the Internet of Things, also known as IoT, which has recently been talked about and found around in everyday life. Briefly, IoT has a concept to expand the benefits of internet connectivity that is connected continuously with the aim that objects around the world can communicate with each other[1]. In principle, IoT is used to facilitate monitoring and retrieval of power on physical goods or devices connected with the help of a sensor which can later communicate to exchange data or transfer data without having to require direct human-to-human or human interaction to a computer which means it can be accessed and used when just anywhere and everywhere.

In communication electronic devices there needs to be a recording system that is used to record communication between devices wherein practice IoT can be ensured that each other's devices will be interconnected or communicate intensely or continuously. So from that this study will explain how the data recording system or commonly called a data logger that functions as a data recording system can then be a reference in order to monitor ongoing communication.

The ability of the data logger can collect data in realtime after this record system is activated, then it will record the information needed during the monitoring period. In this study, the data logger is designed or created to find out information about data transmission between IoT devices in the scope of modern homes. The data recorded in this study is in the form of packet data protocol sent by the device used, namely Arduino and sensor data, which will then be received by other devices from where there will be communication between devices. Data that has been recorded or received will then be saved into the database as the purpose of data logging using the MySQL database. To simplify data monitoring, logging data obtained through Arduino will be displayed on web-based applications, making it easy for users to operate.

II. METHOD

A. *Internet of Things* (IoT)

Internet of Things, better known as IoT, is a technology introduced by Kevin Ashton in 1990. Internet of Things is a concept that is made so that electronic devices can communicate with each other independently and receive and transmit data through the internet[2]. The form of the evolution of interactions between the real world and internet networks is a form of IoT that is able to combine several computational components, internet protocols, and sensors. The combination of components will be an embedded system or embedded system so that all devices can interact more quickly and help all activities to be more efficients[3]. With the Internet of Things technology is expected to be able to make the world smarter.

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B. *Data logging*

Data logging is the process of collecting and recording data from sensor output automatically which aims for archiving or data analysis[4]. Data logging can be used in research monitoring systems that require fast and precise data collection time. Data collected is data from sensors that will convert physical quantities into electrical signals that can be measured automatically and sent to computer devices or microprocessors for processing. To support fast and precise data collection, data logging requires an important element, the data logger. By using a data logger, users can monitor or do data logging for 24 hours continuously and real-time, this allows users to get comprehensive information about the condition of something being monitored. In addition, the data that has been recorded will be stored in offline storage or even online, so that the data can be monitored and analyzed easily and efficiently.

C. Arduino Uno

Arduino Uno is one of the platforms of open source physical computing. Arduino uno is a physical device that uses interactive software and hardware, which means this device can receive stimuli from environments that have analogous properties[5]. Arduino uno is one of the few microcontrollers that exist today and has a CPU, Read Only Memory (ROM), Random Access Memory (RAM), Input-output, timer, interrupt, a clock that are well connected on one chip[6].

Arduino Ethernet Shield is an Arduino PCB that has an add-on circuit board as a platform used with additional hardware, such as temperature sensors, humidity, and other sensors. The Ethernet shield module is designed or made based on the Wiznet W5100 ethernet chip that provides IP addresses with transport protocols in the form of TCP or UDP and is supported up to 4 sockets simultaneously or simultaneously. Use the Ethernet library to write a sketch that is connected to the internet using a shield. This Arduino Ethernet shield has an RJ-45 standard, whereby this standard the device can be connected to other devices using UTP cable media and also added with integrated line transformer and Power over Ethernet (PoE) enabled. In addition this module also has an onboard micro-SD card slot, which can be used to store additional files if needed. For micro-SD card readers this can be accessed through additional libraries, the SD library.

D. DHT-11 Sensor

The DHT-11 sensor is one of the sensors that is often used in the Internet of Things to measure the temperature and humidity values around[7]. The DHT-11 sensor guarantees the reliability and stability of the read data, besides that this sensor also has the best quality when viewed from the response and reading of data that requires fast time.

E. *Research Methodology*

The research method conducted by the author is illustrated by a flow diagram as shown in Figure 1.

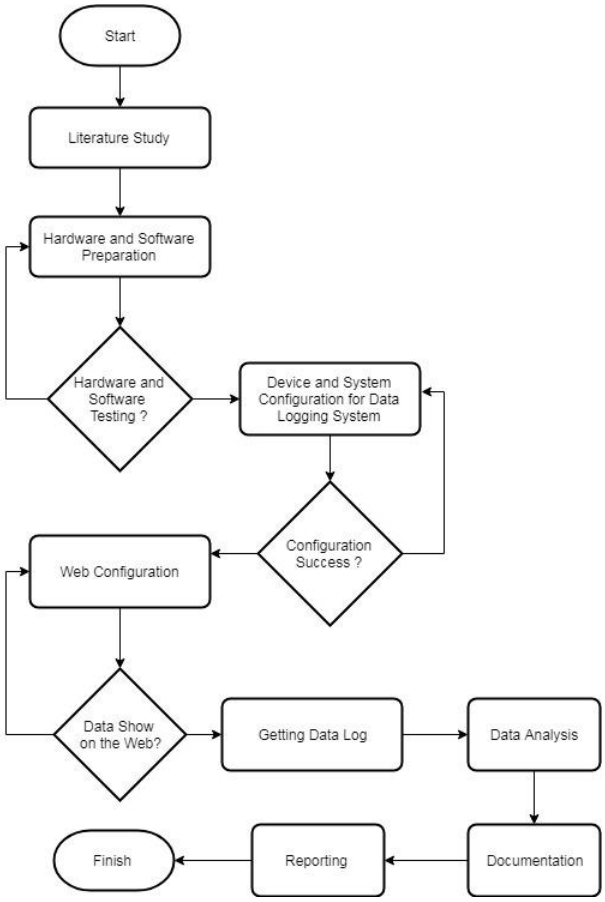

Figure 1. Research Flow

F. *System Design*

In figure 3. Research topology shows the topology or system design in this study, there is a router that serves to connect public and local networks. Next, it is connected by a switch as a connector for 2 Arduino, server and Client PC.

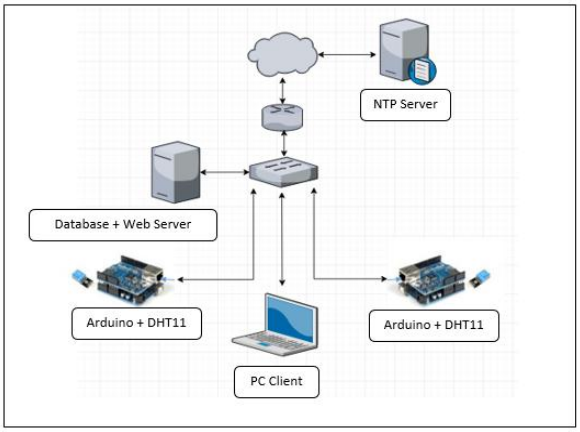

Figure 2. Research Topology

In this study, there are 2 data logging processes carried out, namely the process of logging data communication of Arduino devices and the process of data logging sensors installed on Arduino devices namely DHT 11. The flow of the data logging communication process starts from an Arduino device that requests a request time to the NTP server centrally, after requesting a request to the NTP Server via the internet network that has been installed as shown in Figure 3, then the NTP server receives the request and then sends the request back to the Arduino device. For temperature logging data starting from an Arduino device installed the sensor requests a request from the sensor to send the temperature which is then processed and stored by Arduino. Data logging that has been processed from both of them will then be stored in the available database server and will then be forwarded to the web server for processing. The data that has been obtained is processed and will be displayed on a web server in which there is information from data logging tables, logging data reports and graphs to clarify the movement of data that has been processed.

G. XAMPP

XAMPP is a tool developed by the project team named Apache Friends in 2002. XAMPP is a tool that provides software packages into one package. In the package contained in XAMPP there are Apache (web server), MySQL (database), PHP, Perl, Filezilla FTP Server, and PhpMyAdmin, using XAMPP users do not need to manually install and configure Apache, PHP and MySQL web servers[8].

H. PHP

PHP (the acronym of PHP Hypertext Preprocessor) is a standard language commonly used in the world of information technology, which when viewed from the history of PHP's initial creation from Rasmus Lerdof's idea for his personal needs, the script is actually intended to be used to create personal websites, but then developed again so that becoming a language called "Personal Home Page" is the first step towards the emergence of PHP until now[9].

I. MySQL

MySQL is commonly known as a database management system (DBMS) which has the ability to run SQL very quickly with multithread and multiuser[10]. With these capabilities make MySQL very popular in web applications that function as data storage or commonly called a database. The nature of MySQL is relational, which means that the data managed in the database will be placed on several separate tables so that manipulating data will be faster.

III. RESULT AND DISCUSSION

In this study produced a design result in the form of a tool and system from the Arduino device communication logging data on the Internet of Things which can be seen in Figure 4 below.

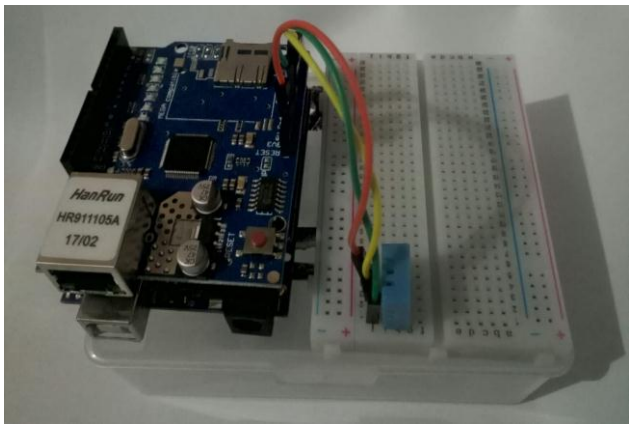

Figure 3. Data Logging Device Realization Results

The tool designed in this study is an Arduino device paired with an Arduino Ethernet shield module with specifications inside it is HanRun HR9111 and DHT 11 temperature sensor is added as depicted in Figure 4. The tool is equipped with a plastic-based box which aims to protect various tools conditions and can still control the status of the device from the indicator or the lights of the device.

In addition to producing a hardware device, in this study, there is software that is a system of data logging. In it there is a display for displaying data logging that has been made such as Arduino device communication logging data and DHT sensor logging data 11. In Figure 5 is a dashboard display from the results of software or system realization in this study.

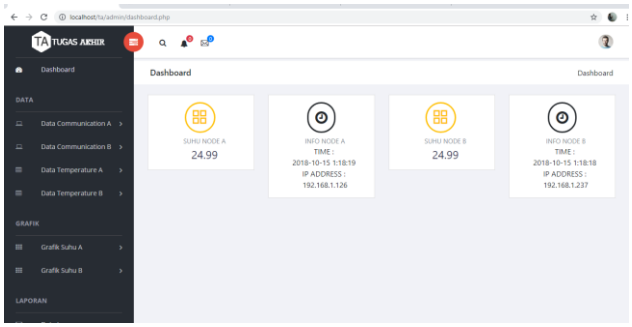

Figure 4. Data logging system dashboard

A. Display of MySQL Databases

Results from data logging that has gone through several processes to be stored in the database server. In this study there are 4 tables, namely, communication data table Node A, communication data Node B, temperature data Node A and temperature data Node B as in Figure 5, Figure 6, Figure 7 and Figure 8 as follows.

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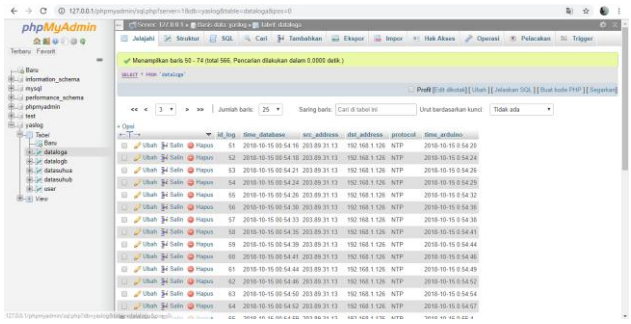

Figure 5. Data logging display Communication Node A

In Figure 5 above is a table of communication logging data on Arduino Node A. The database presents information on the results of logging data that has been recorded and then stored on the database server. So as can be seen in Figure 4.16 that the time_arduino obtained comes from the NTP Server IP Pool address that acts as source_address or the source address from which time Arduino was obtained. The address of the source address obtained is 203.89.31.13 and gives the result of that time with the destination IP address which is the address of the Node A device, namely 192.168.1.126. In addition to the time that comes from the NTP Server, this table also presents database time derived from timestamp data types. Data entered into this database ranges from 2-4 seconds.

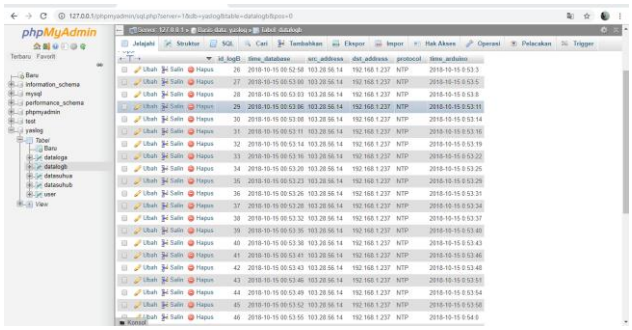

Figure 6. Display logging data Communication Node B

In Figure 6 above is a table of communication logging data on the Arduino Node B. The database presents information on the results of logging data that has been recorded and then stored on the database server. So as can be seen in Figure 6 that the time_arduino obtained comes from the IP Pool address of the NTP Server which acts as source_address or the source address from which time Arduino was obtained. The address of the source address obtained in the Bad Node is 103.28.56.14 and gives the result of that time with the destination IP address which is the address of the Node B device, namely 192.168.1.237. In addition to the time that comes from the NTP Server, this table also presents database time derived from timestamp data types. Data entered into this database ranges from 2-4 seconds.

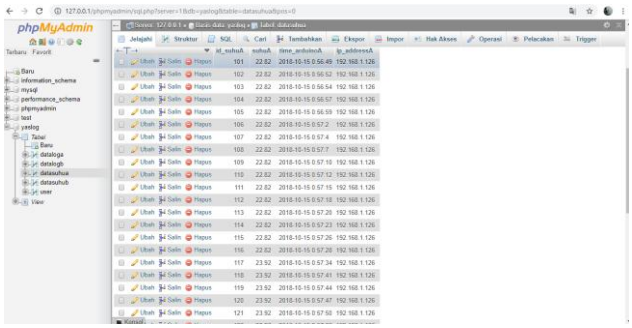

Figure 7. Display of logging data Temperature of Node A

In Figure 7 above is a table of temperature logging data on Arduino Node A. The database presents information on the results of logging data that has been recorded and then stored on the database server. So as can be seen in Figure 4.18 we can read and understand the data stored in this database. The recorded temperature data is 22.82 with the temperature collection time being on October 15 2018 at 00:56 and added the identity of the Node A IP address, namely 192.168.1.126. Data entered into this database will be updated in realtime ranging from 2-4 seconds.

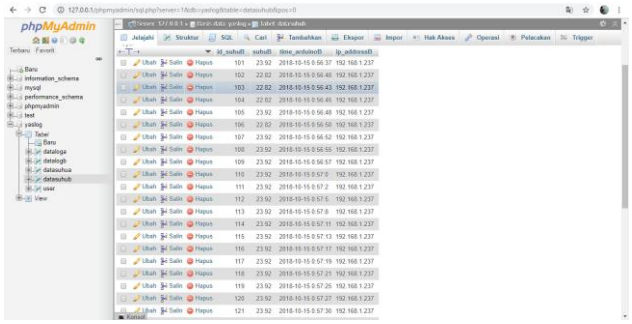

Figure 8. Display logging data Temperature Node B

In Figure 8 above is a table of temperature logging data on the Arduino Node B. The database presents information on the results of logging data that has been recorded and then stored on the database server. So as can be seen in Figure 8 we can read and understand the data stored in this database. In Figure 8, the recorded temperature data is 22.92 with the temperature collection time being on October 15 2018 at 00:56 and adding the identity of the Node B IP address which is 192.168.1.237. Data entered into this database will be updated in real-time ranging from 2-4 seconds.

B. Display of Web Table Data

Output or display results from data logging consisting of 4 tables, namely 2 communication logging data tables and 2 data logging tables of temperature sensors. This web uses PHP, CSS and JavaScript programming. Examples of configuration results or web programs can be seen in Figure 9 for communication data logging tables and Figure 10 for temperature logging data tables.

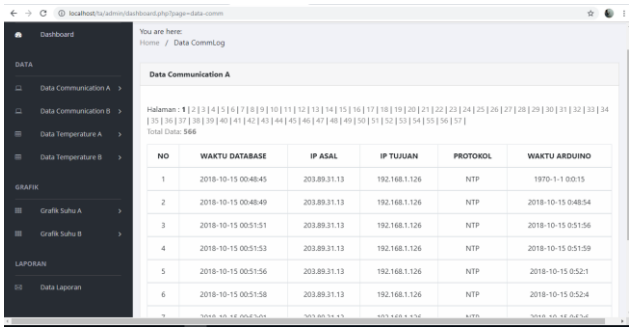

Figure 9. Page Data Logging Communication Table

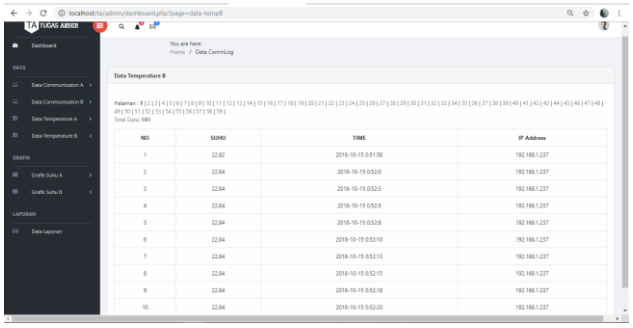

Figure 10. Page Temperature logging data table

In Figure 9 and Figure 10 is a communication logging data table and temperature table of an Arduino device consisting of 2 Nodes. On the page contains a table whose data will always be updated in realtime and the web is made reload or refresh to make the data in the table always updated with an updated range of 2-4 seconds. To give a neat impression to the table, a pagination function is added for table bounding so it doesn't get too down and seems irregular. Pagination on this page is given per page there are 10 lines, so when the data has reached 10 and the 11th will automatically move to the next page.

C. Web Graph Display

In a data logging table system alone is not complete in making this system, the need for graphs that can real-time show a graph of the development of data logging that occurs on devices in this system. The graph is made for temperature sensor logging data which is displayed is the temperature and time data that will run and update in real-time.

In Figure 11 and Figure 12 is a graph of temperature logging data from an Arduino device consisting of 2 Nodes. On the page contains a graph whose data will always be updated in realtime and the web is made to reload or refresh to make the data in the graph always updated with a range of updates 2-4 seconds. The graph will always display data that is generated from sensor data and time on the Arduino device in both Nodes.

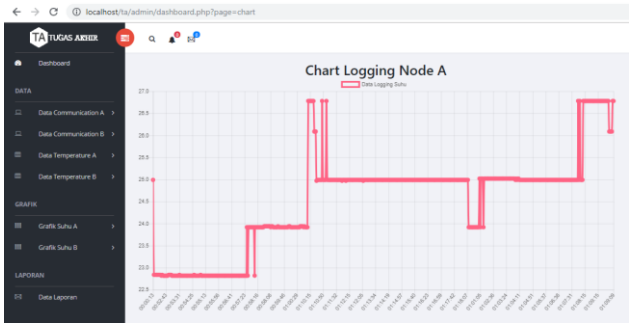

Figure 11. Temperature logging data graph

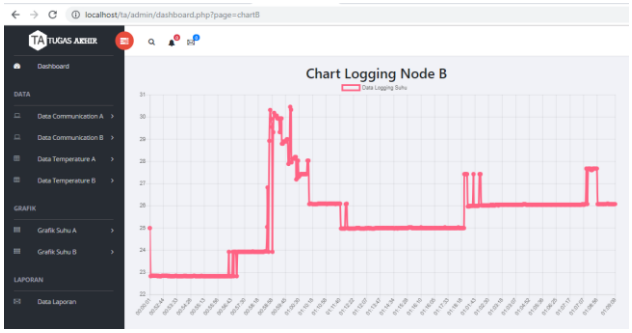

Figure 12. Temperature logging data graph

D. Testing of Data Logging Reporting Results on the Web

To ensure that the reporting results made can be used properly. Reports that have been recapitulated can be stored neatly in files with the Microsoft Excel extension, .xls. Besides being able to be downloaded and stored this reporting can be easily printed directly. With the print and download model, this data logging system does not require an additional SD-Card to store the results of logs that have been recorded and processed but by utilizing web-based application programming. Printable reporting data originates from the table page on the weblogging data system page. The following is a reporting page from the data logging system which can be seen in Figure 13.

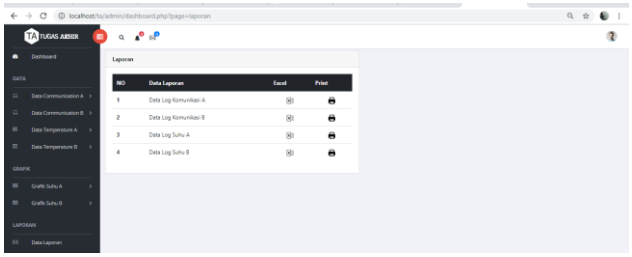

Figure 13. Data logging Web Reporting page

In Figure 13 is the display of report data web pages from the data logging system. On this page, there are 4 report data according to table data stored in the yaslog database. The report in Figure 13 can be stored and printed easily, just by clicking on the icon with the printer logo or MS. Excel. The results of the trials when selecting the printer icon can be seen in Figure 14 and the MS icon. Excel in Figure 15.

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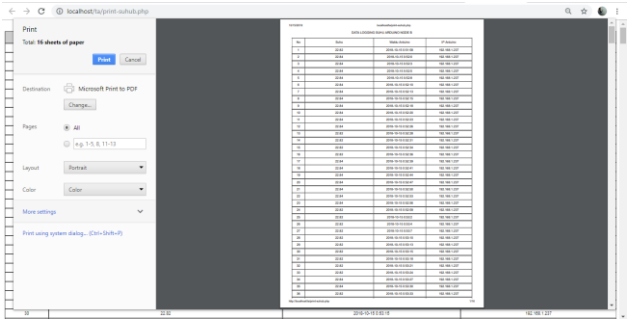


Figure 14. Test Results Print a Data logging report

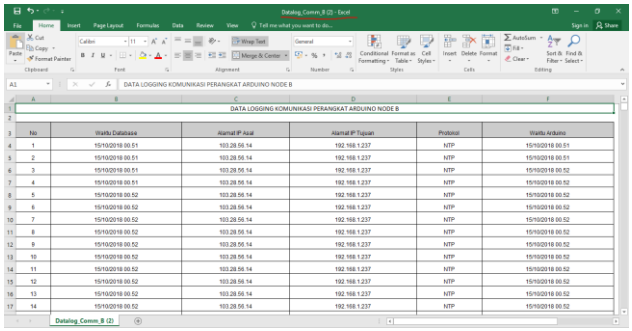
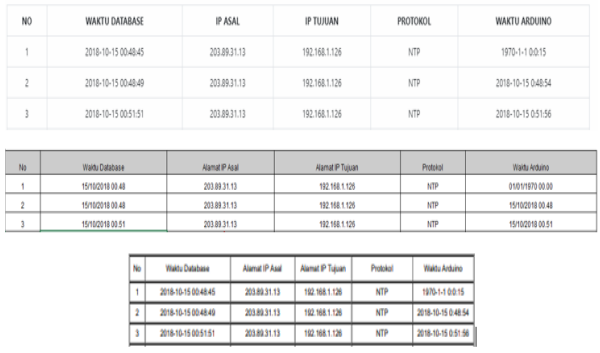


Figure 15. Data Logging Save Test Results

Figures 14 and 15 are the results of reporting from tables obtained from MySQL databases that are stored as yaslog. The table is packaged in a table that is converted into an excel and executes print file.

To ascertain whether the data entered from the database automatically has the same output value from the destination database source. In Figure 16 below, it shows that among the three tables originating from the page table, the excel and print view reporting files show all three data are the same and accurate, so the data processed and displayed on the web is then used as reporting with the .xls function file and running well.



NO	WAKTU DATABASE	IP ASAL	IP TUJUAN	PROTOKOL	WAKTU ARDUINO
1	2018-10-15 00:48:45	203.89.31.13	192.168.1.126	NTP	1970-1-1 0:0:15
2	2018-10-15 00:48:49	203.89.31.13	192.168.1.126	NTP	2018-10-15 0:48:54
3	2018-10-15 00:51:51	203.89.31.13	192.168.1.126	NTP	2018-10-15 0:51:56

No	Waktu Database	Alamat IP Asal	Alamat IP Tujuan	Protokol	Waktu Arduino
1	15/10/2018 00.48	203.89.31.13	192.168.1.126	NTP	01/01/1970 00.00
2	15/10/2018 00.48	203.89.31.13	192.168.1.126	NTP	15/10/2018 00.48
3	15/10/2018 00.51	203.89.31.13	192.168.1.126	NTP	15/10/2018 00.51

No	Waktu Database	Alamat IP Asal	Alamat IP Tujuan	Protokol	Waktu Arduino
1	2018-10-15 00:48:45	203.89.31.13	192.168.1.126	NTP	1970-1-1 0:0:15
2	2018-10-15 00:48:49	203.89.31.13	192.168.1.126	NTP	2018-10-15 0:48:54
3	2018-10-15 00:51:51	203.89.31.13	192.168.1.126	NTP	2018-10-15 0:51:56

Figure 16. Test Results Data logging table

IV. CONCLUSION

Based on the data obtained and the analysis that has been done, it can be drawn some conclusions from the research, including, the Internet of Things tool can record a data package, this is based on testing communication with the host server on the internet network. NTP Server can be used as time synchronization in a data logging system, without having to use additional modules such as the RTC (Real Time Clock) module. Arduino can be used as a data logger with the data taken is an installed sensor data and data logger for network communication. The resulting log data can provide communication information that occurs, such as the origin address, destination address, address of the device identity and time of the device as well as information on room temperature displayed in real-time. MySQL databases are used to store communication data and sensors that have been processed to be stored as log data purposes. The website can display information on communication logging data and sensors with tables, graphs and reports that can be stored and printed, so that they can monitor anytime in real time.

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