International Journal of Science and Technology Research Archive

ISSN: 0799-6632 (Online)

Journal homepage: https://sciresjournals.com/ijstra/

(RESEARCH ARTICLE)

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Wireharness continuity test equipment design microcontroller-based aircraft module and atmega328p NRF24l01+ Wireless

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International Journal of Science and Technology Research Archive, 2023, 04(02), 001–011

Publication history: Received on 09 March 2023; revised on 23 April 2023; accepted on 26 April 2023

Article DOI: https://doi.org/10.53771/ijstra.2023.4.2.0056

Abstract

In the manufacture of aircraft there are systems - systems that are very complex and must be integrated with each other, these systems are integrated with each other with wireharness transmission media. Wireharness is a collection of cables that are tied to form a bundle into a single unit. The continuity testing tool available today uses a multimeter, the disadvantage of using a multimeter is that it takes a long time to carry out because it must be tested one by one point to be tested while there are quite a lot of points to be tested, both operators often have difficulty when looking for cable addresses on the wirelist, the three tools used are not flexible. The purpose of this research is to design and make an aircraft wireharness continuity test tool that can test quickly because it can test many points at the same time, makes it easier for operators when looking for cable addresses on the wirelist, and is flexible when testing because it can measure two points that are quite far apart. far compared to a multimeter probe. This tool has two parts master and slave and each part uses an Atmega328p microcontroller-based controller as a data processor. Then also used 2 CD74HC4067 ICs, namely a 4 to 16 line multiplexer/demultiplexer whose binary output is controlled by a microcontroller. As well as for unidirectional communication between master and slave using NRF24l01+ (wireless). To operate the tool and display the results of the wireharness test, an application program was created using Visual Studio 2010 with the Visual Basic programming language. The system created will be realized into hardware capable of conducting a continuity test of 32 connection pin points in a multipoint to multipoint manner. After all systems are realized, then further testing is carried out on the tool, where this test is carried out to find out whether this tool can operate in accordance with what was planned. In continuity testing with this tool, it is able to produce good tests because it is able to carry out multipoint continuity tests and the communication distance between master and slave is 20 meters, and the testing time using this tool is 46.2% faster than using a multimeter. By using this continuity tester to speed up the work, the result is safer because the cable connections are not confused, can test the connection is disconnected or connected.

Keywords: Continuity Test; Wireharness; ADDIE; Aircraft; Atmega328p

1 Introduction

PT. Dirgantara Indonesia (Persero), commonly known as PTDI is one of the aerospace companies in Asia that has competence core in aircraft design and development, aircraft structure manufacturing, aircraft production, and aircraft maintenance for both civilian and military aircraft[1]. In producing aircraft, there are several important systems including electrical systems, hydraulics, navigation, flight control, and others. All these systems are integrated with each other through a guided transmission medium called wireharness[2]. Wireharness is a set of cables that are tied together so as to form a bundle of cables so that they become a single whole[3]. As it progresses, PTDI is expected to be able to

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complete every aircraft production it makes in a fast time[4]. Based on the facts found in the field, in the process of manufacture wireharness this still experienced delays in its completion, thus creating delays in the process of completing the production of each aircraft. At wireharness has a different length and number of cables in each maintained system, starting from the size 1 meter to 20 meters with the number of wires on each wireharness up to dozens of cables. There are several factors that are problems in producing wireharness so that this makes the occurrence of delays, one of the factors is in one of the stages of its operation, namely the continuity test (continuity test)[5].

Continuity test is a procedure to determine whether or not a power line can be built between two points in an electrical circuit[3][6]. And with the facts in the field when carrying out the stages of continuity operations on the plane there are obstacles that make the operating stages long to do because to carry out continuity tests wireharness at this time it is by manual means using a multimeter[6][7]. There are several problems that are factors that cause the testing time to be long. The first is the tools used to perform tests that are less reliable and take a long time[8]. Currently the test is carried out only with a measuring instrument in the form of a multimeter[9][10], which can only test one point per connector on wireharness. Whereas the point to be tested for continuity is pthere is every connector very varies from a few points to dozens of points[5]. Meanwhile in a bundle wireharness there are at least 3 connectors. The second is that operators often have difficulty when finding cable addresses on wirelist[11]. Wirelist is a book containing cable addressing wireharness. More and more cables are attached to wireharness hence the more pages and the thickness of the wirelist. All three tools used are inflexible[12]. As a result of the problems raised above, a tool that can perform continuity testing for many points in a fast time is needed, as well as a system that allows operators to read cable addressing more easily. To make it easier for the operator to use it, the two options above can be combined into a unified system. If the above problems can be solved with this tool, then the continuity test time will increase, and the production of aircraft at PTDI will not be delayed anymore[3][7].

2 Material and methods

The research method used is Analysis, Design, Development, Implementation, Evaluation (ADDIE)[13]. The ADDIE research method is one method that is often used in research to produce an industrial product or appropriate technological tool[14].

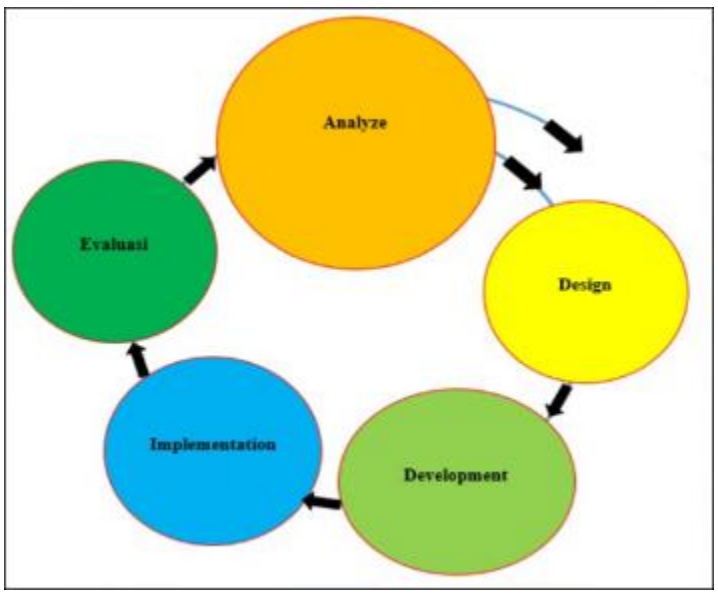

Figure 1 Research method flowchart

2.1 System Design

TheAtmega328p Minimum System serves to send and receive data on the test of this system, then process the data[15]. There will be two pieces of atmega328p minimum system, the first as master and the second as Slave[16]. Communication between master and Slave this will use the module Wireless NRF24l01+, Atmega328p minimum system as master will connect to a computer with serial communication in order Output continuity test results can be displayed

in user intefarce on the computer. Below is the circuit schematic of the system minimum atmega328p microcontroller to be made.

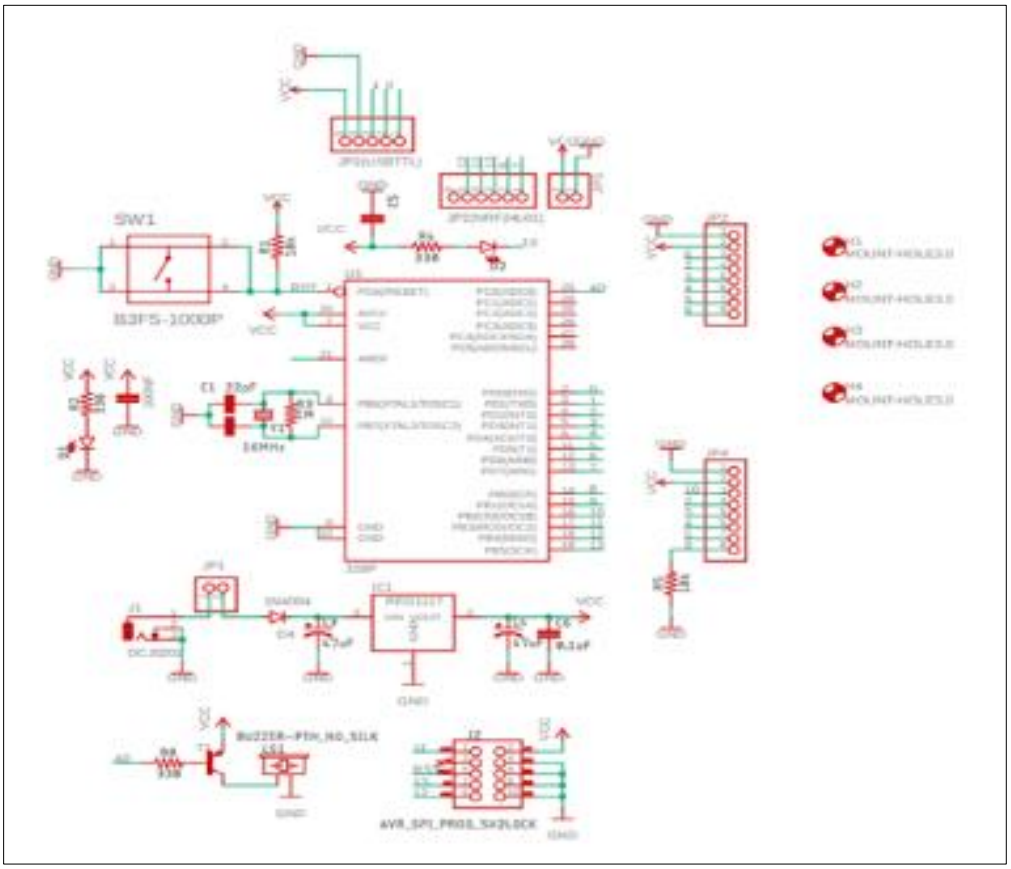

Figure 2 Atmega328p minimun system

In this design, 32 PC817 type Optocouplers will be made for each Master and Slave. This optocoupler will connect to pins A0 through A15 on the Master and Slave Multiplexers, for its connection using the DB37 connector. The interface application program serves to make it easier for operators who will operate continuity testing tools. This application program is designed and built using microsoft Visual Studio version 2010 software[17]. This application program can access all the information that has been processed by the minimum system of master microcontrollers. In addition all control panels for continuity testing are also embedded in the application program of the interface[18]. This application program communicates with the minimum system of the master microcontroller through serial communication. To be able to communicate with the minimum system of the master microcontroller, the communication uses USB TTL PL2303HX on the COM port on the PC or laptop[19]. The following is an overview of the communication between the interface application program and the minimum system of the master microcontroller using USB TTL PL2303HX:

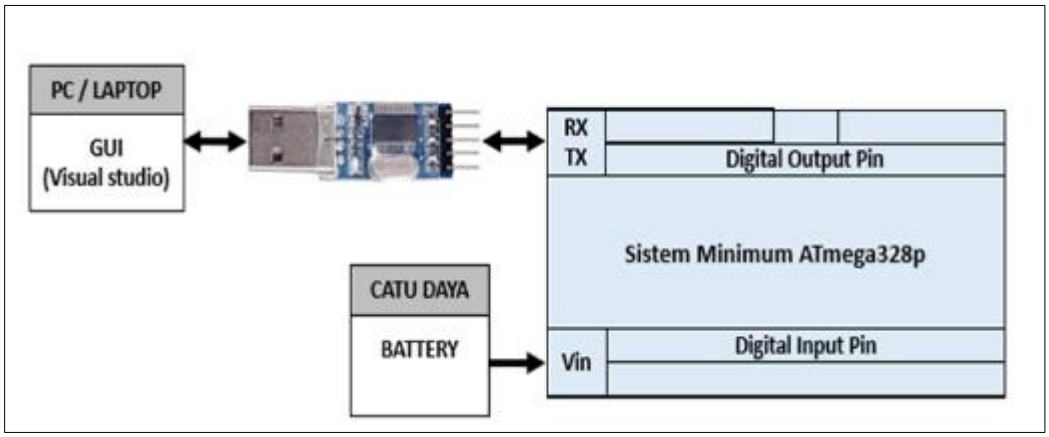

Figure 3 PL2303HX serial data communication and Microcontroller

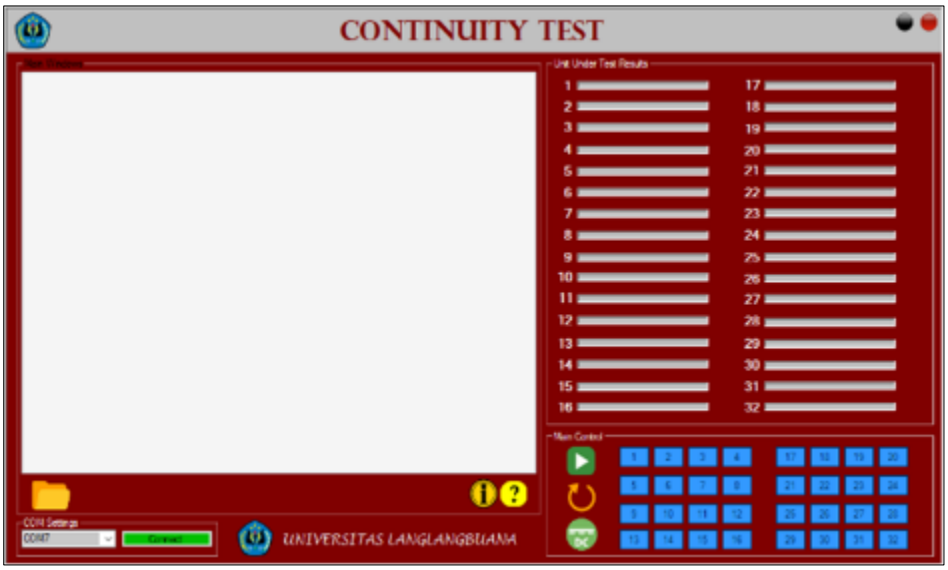

Figure 4 User interface design

2.2 Diagram Blocks

Below is a picture of the diagram block, this circuit will work wirelessly in terms of communication between 2 microcontrollers. Where the master microcontroller will send data in the form of addresses to the microcontroller 2 slaves. The data received by the slave microcontroller will be processed and forwarded to the output pin of the slave microcontroller to control the demultiplexer according to the address sent by the master microcontroller, the output of the slave demultiplexer will send a signal in the form of voltage to the optocoupler to output a voltage of 8.4 Volts to each connector pin point as per the output of the demultiplexer as feedback to the master microcontroller[18]. Such feedback will be detected by the master microcontroller by means of an optocoupler installed in the master section. When feedback is detected by the optocoupler, the optocoupler will send a signal to the multiplexer and then enter the master microcontroller. The data received by the master microcontroller will be processed and the results will be displayed on a computer or laptop.

Each data sent by the master microcontroller has a different address, the address sent by the master microcontroller to the slave microcontroller and returned again to the master mikrontoler as feedback through the wireharness intermediary, the address must match the one sent so that the master microcontroller can be received. If the addresses between the master microcontroller and the slave microcontroller are not the same then continuity will not occur.

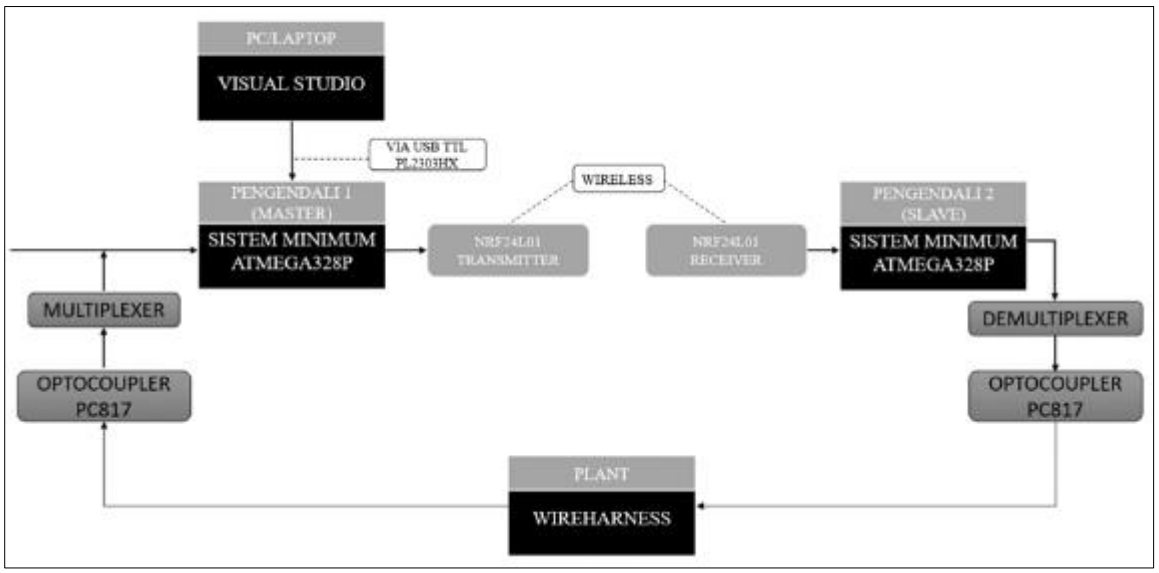

Figure 5 System diagram block

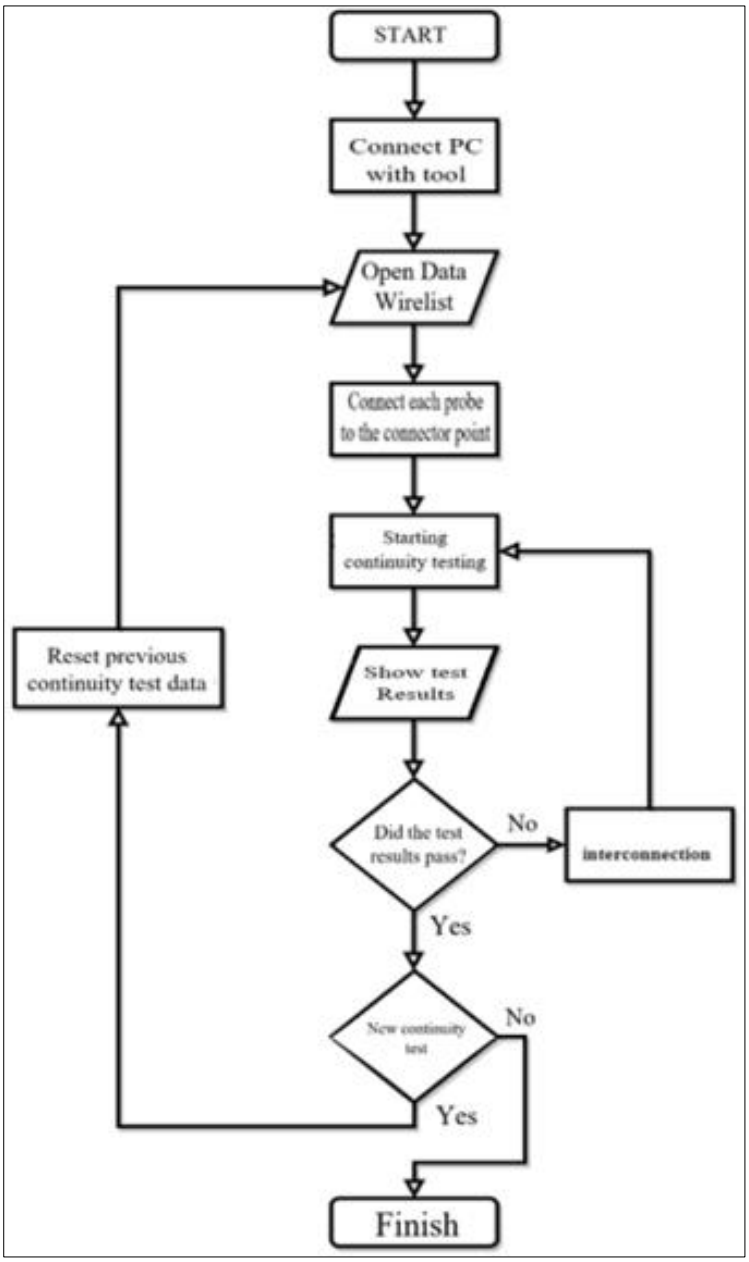

Figure 6 System diagram block

The flow chart above illustrates the operating steps of the continuity testing tool wireharness. Here is a further explanation of the flow chart above:

- Connect the computer with the tool: Connect the computer with the continuity testing tool and make sure it is connected.
- Open wirelist data: Enter the wirelist data into the application program. Wirelist data is created in the "*.xls" format in Microsoft Office Excel. The information contained on the wirelist is:
    - Master probe/ Slave probe: is a label on the probe to mark the continuity test sequence.
    - Wire: is the naming of each cable on wireharness.
    - 1st Element/2st Element: is the name of the connector address on wireharness.
    - Terminal: is the point where the cable is connected to the connector.
- Connect each probe to a point on the connector: Mconnect the probe to the point on the connector according to the addressing on the wirelist.

- Start continuity testing: Once all probes are connected then the continuity testing process can be carried out. To start the test can be by activating the command button on the application program interface.
- Show test results: Next the interface application program will display the results of the continuity test.
- If there is a continuity test failure, then go to the interconnection fix step, which is to troubleshoot to find the cause of the test failure. If continuity testing does not occur failures, then go to the next step.
- To perform continuity testing at wireharness others, then go to the step Continuousity test data reset to meReset previous test data and return to the first step. If you will not test again, then the testing process is considered complete.

3 Results and discussion

3.1 Continuity testing

This wireharness continuity test was performed on one of the wireharness samples as shown in Figure 7 below:

Figure 7 Wireharness sample

The first step for testing is to connect the master with the PC / laptop using a USB cable, then run the interface application program that has been created and the main window will appear. In the main window there is a COM setting, this is useful for choosing a COM port that is connected between the PC / laptop and hardware. To find out what number com *port* is connected, it can be seen by opening the *device manager.* If the COM port number is correct then press the *connect* button on the main window to connect the PC / laptop with hardware. Then a small window will appear with a message that the PC / laptop with the testing tool is connected or connected.

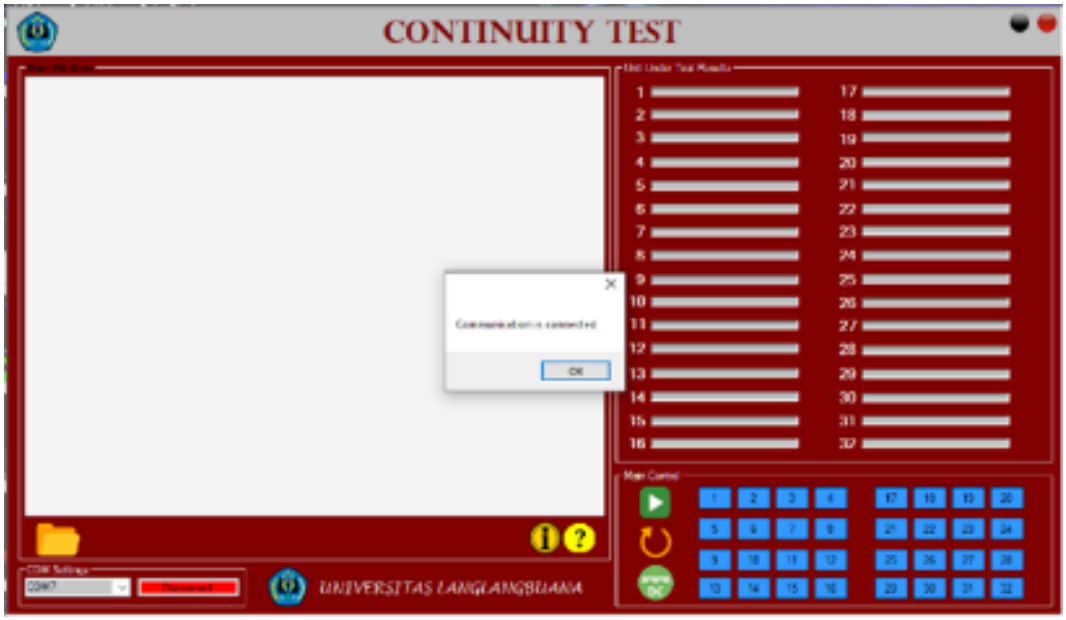

Figure 8 Continuity Test

To start continuity testing on a wireharness then we need data from cable addressing wireharness aforementioned. Data from addressing wireharness it is found in wirelist. To open wirelist press the symbol key folder at the bottom left of the main window. When clicking the button folder then a new window will appear and select the data file wirelist to be included. Data wirelist has been created in file format"*.xlsx) |*.xlsx| (*.xls)|*.xls|" or Microsoft Office Excel. Then click the oven on that new window and data wirelist will be inimport and will appear in the main window as in Figure 9 Under.

Figure 9 Main window with wirelist data

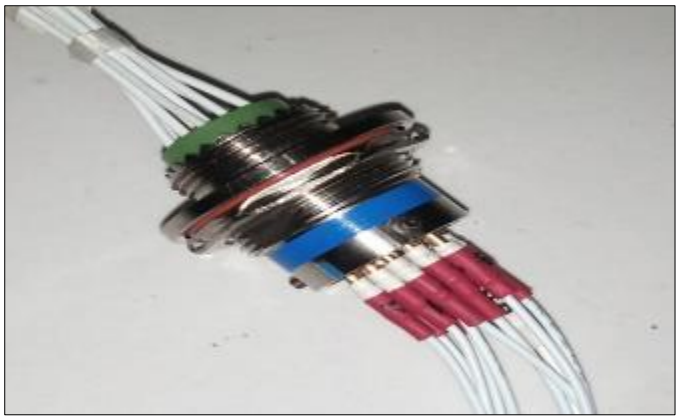

Figure 10 Interconnection between Probe and Wireharness

Probe testing according to the data on wirelist. Calculation of the time started when starting the interconnection on Point first on wireharness. Then ensure interconnection between Probe and wireharness is appropriate. For continuity to occur, connect ground probe between master and Slave. Linking ground probe this could take advantage of either Point which corresponds to the cable addressing data on wirelist.

To start the test, first press the button with the symbol "DC" shown in Figure 9. This button activates the voltage input into the wireharness. Then, press the run test button to perform the automatic test. Alternatively, you can manually test each wire by pressing the corresponding number key displayed on the interface's main window. Each number corresponds to a specific test probe. For this wireharness sample, there are only 10 wires, so you should connect probe number 1 to probe number 10. Once the test is initiated, wait for the tool to finish testing the continuity. The results of the continuity test will be displayed on the right side of the interface program. If the continuity is successful, there will be a blue line indicator and a green check mark. In contrast, if the continuity fails, there will be a red line indicator and a red cross as shown in Figures 11 and 12 below. Based on the continuity testing results in Figures 11 and 12, it can be concluded that the wireharness has good continuity.

3.2 Continuity testing

After continuity testing experiments were carried out on wireharness samples, the results of the duration of the test time from each experiment were as follows:

Figure 11 Test results automatically

Figure 12 Test results manually

According to the data obtained in the table above, the duration of testing using this continuity test tool is 2 minutes 8 seconds faster than testing using a multimeter tool. So that if viewed in percentage terms, testing using this continuity test tool is 46.2% faster in duration than testing using a multimeter tool.

3.3 Specifications

Table 1 The spesification of the tool

No.	Testing tools	Test results	Duration of testing
1	Multimeter	Passed	6 minutes, 12 seconds, 60 seconds
2	Continuity test kits	Passed	3 minutes, 21 seconds, 09 seconds

The spesification of the tool to be made is as follows:

- This tool has 32 point points (probes) for continuity tests.
- Communication range between Master and
- Slave can cover distances of up to 20 meters and even more using NRF24l01+.
- Cable lengths that can be tested accordingly with a communication distance between the Master ……and the Slave which is more than 20 meters.
- Control testing tools using users
- interface communicated with the tool using USB TTL PL2303HX.
- Power supply using 2 batteries
- 18650 (rechargeable) with specifications
  - Brand = Sony VTC 4a
  - Voltage = 8.4 Volts
  - Capacity = 2100 mAh
  - Battery life = 26.56 Hours
- The controller uses ATMega 328p.
- Voltage input at the appropriate wireharness with battery voltage.
- 46.2% faster continuity testing compared to using tools auxiliary multimeter.

4 Conclusion

After designing, making and testing – the tests and analysis carried out can be drawn several conclusions, namelythis lat works well where we can do continuity tests manually or run tests. As well as alat this portable can be carried easily so that continuity testing can be done anywhere. All components after testing function properly and according to what is desired and as planned. The voltage in the power supply sourced from the 18650 battery of 2 pieces assembled in series can last for 26.5 hours, so that the tool can be functioned longer. And for charging the battery can use a 9 Volt

charger with a current of 1 Ampere. The length of the cable that can be tested can be up to 20 meters more, the voltage drop or current can still be resolved due to the voltage and direct current from the battery. Where the voltage entering the wireharness ranges from 7 - 8.4 Volts and the incoming current can be up to 1 A. With this tool the operator can more easily carry out continuity tests and easier to read wirelist data. For the results of testing the functionality of the tool, it functions according to expectations in continuity testing on one of the wireharness samples. And with this tool wireharness continuity testing is 46.2% faster compared to using a multimeter.

Compliance with ethical standards

Acknowledgments

A big thank you is conveyed to all those who have helped and been involved in this research, without the support and assistance of all of them, this paper will not be completed and the objectives of this research will not be achieved.

Disclosure of conflict of interest

The authors state that there are no personal, financial, or organizational conflicts of interest that may affect the output of this research.

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