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Design and Implementation of a Shunting Communication Voice Recorder at Tegal Station Using Visual Basic

Firda Dwi*[1], Natriya Faisal Rachman[2], Agustinus Prasetyo[1]

[1]Teknologi Elektro Perkeretaapian, Politeknik Perkeretaapian Indonesia, Jl. Tirta Raya, Pojok, Nambangan Lor, Kec. Manguharjo, Madiun 464788, Jawa Timur, INDONESIA
[2]Electro Technical Officer, Politeknik Pelayaran Surabaya, Indonesia Jl.Gunung Anyar Boulevard No.1, 60293 Jawa Timur, INDONESIA

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Abstract

Communication between the two is done using a handy talky. Communication between langsir officers and train travel organizers is one of the most influential communications in train operations. In (PM No. 45 of 2018) concerning the technical requirements of railway telecommunications equipment, it is stated that at least lansiran communication meets the operating system requirements, every conversation must be recorded. There is currently no recording device for alert communication at Tegal station, while the alert process at Tegal station occurs at least 8 times a day.In this study, an application was made to record the voice of the langsiran communication to record all communications made by the langsir officer and the train travel controller. By taking voice data from the handy talky which is used as a master, then it is connected using a series of interfaces via a cable jack on a PC that has installed a voice recording application for langsiran communication that has been made with Microsoft Visual Studio. The recorded data that has been obtained is processed and stored in a MySQL database with the phpMyAdmin interface.From the test results, the designed software can be run properly, can automatically record alert communication, the stored data can be searched based on the recording code and recording date, and the recorded recordings can be played back and show the recording time

Keywords: Alert communication, voice recorder, database, visual basic

Corresponding Author:

Name: Firda Dwi
Email: frida.tep1931@taruna.ppi.ac.id

1. Introduction

Shunting operations in railways are essential for supporting train operations, such as assembling, adding, reducing, or disassembling train formations. The shunting process must be conducted under

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strict procedures, and only authorized personnel can oversee it. At station yards, shunting operations are performed based on instructions from the Station Master (PPKA) and executed by shunting staff. The PPKA's responsibilities include adjusting the position of switches according to the shunting direction and coordinating with the shunting staff through communication. The shunting staff then follows the PPKA's instructions and leads the entire shunting process.

During shunting, the PPKA and shunting staff maintain communication from the start to the end of the process using handy-talkies or radio rigs. This communication plays a critical role in railway operations. According to Ministerial Regulation No. 45 of 2018 on the technical requirements for railway telecommunication equipment, shunting communication must meet operational standards, including recording all conversations. However, the Tegal railway station currently does not have any recording equipment for shunting communications. Based on data from PT. Kereta Api Indonesia (PT. KAI), shunting operations at Tegal station occur at least seven times per day.

The high frequency of daily shunting increases the risk of miscommunication between the PPKA and shunting staff, which may lead to incidents. One such incident occurred during shunting operations at Tegal station, as reported by PT. KAI for the 2020–2021 period. The incident involved a train derailment caused by miscommunication between the PPKA and the shunting staff. However, it is difficult to verify the exact cause of the incident due to the lack of a communication recording system to trace the conversation history between the two parties.

Given these challenges, a voice recording system and database are necessary to facilitate the retrieval of communication records between the PPKA and shunting staff in the event of an incident or violation. This system would serve as an essential tool for ensuring operational safety and accountability. Therefore, the development of a shunting communication voice recorder using Visual Basic for Tegal station is critical to addressing these issues. Such a system would enhance operational safety by providing a reliable record of all communications during shunting operations, thus reducing the potential for future incidents and improving overall railway operations.

2. Methode

In this research, the tool design method is divided into two, namely hardware design and software design as follows.

2.1. Hardware Design

This hardware design is used to get clear and good langsiran communication voice recording results. with the following conditions:

a. Components

The components used in making this tool are HT, jack cable, laptop, and interface circuit.

b. Tool working system

In Figure 1. the working system of the voice recorder for alert communication uses 3 CP1660 motorola handy talkies. The first handy talky is used by the dispatcher on the train that will carry out the dispatch process, the second handy talky is used by the train travel regulator to communicate with the dispatcher, then for the last handy talky is placed in the train travel regulator room to be connected to the PC through the interface circuit using a jack cable. The last handy talky is used to capture the communication between the train dispatcher's handy talky and the PPKA's handy talky, then the train dispatcher's and PPKA's communication goes through the jack cable and interface circuit to the PC that has been installed with a voice recorder application using Visual Basic and MySQL database.

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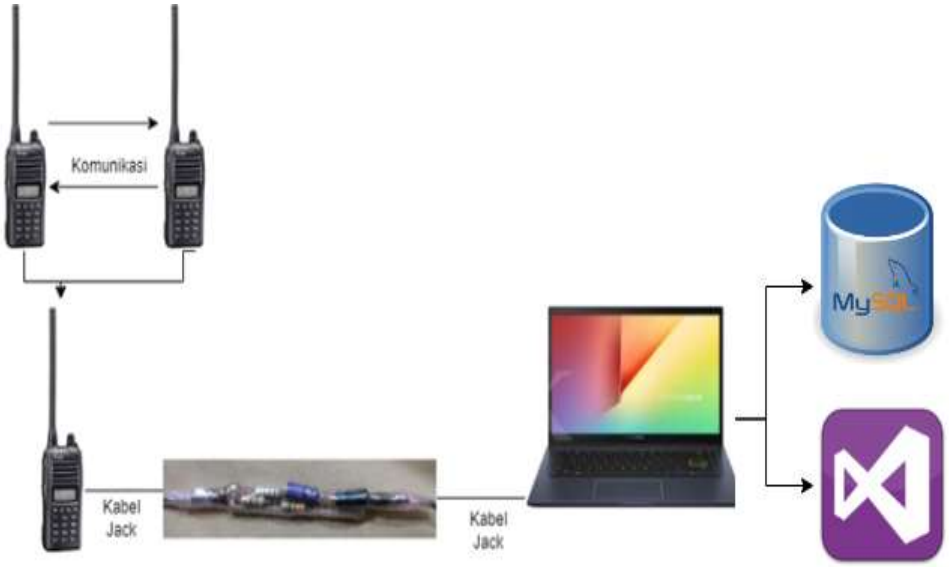

Figure 1. Tool Working System

2.2. Software Design

The components that have been connected are then integrated with the langsiran communication voice recorder software, the software design is as shown in Figure 2 to Figure 5.

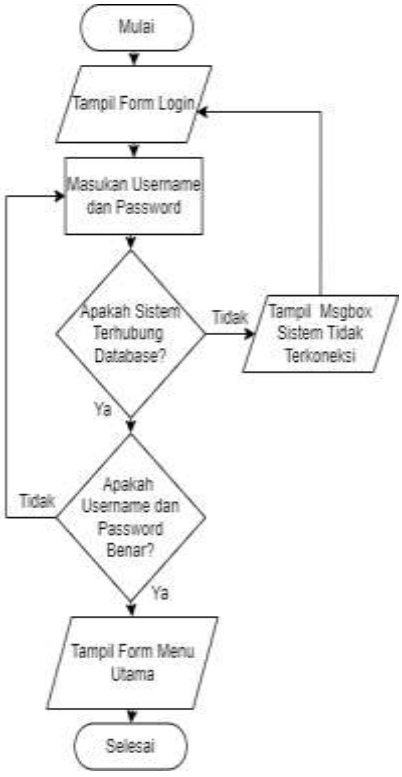

Figure 2. Flowchart Login

Login is the earliest display that will appear when the program is started, it will display a login form where there is a login button, cancletextbox to input username and password. When the username and password are inputted, the programme will perform several validations. The first validation is to check whether the program is connected to the local server, if it is not connected then the program will

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display a message box that says 'The system is not connected' but if it is connected then the program will continue to the validation process of matching username and password data according to the data contained in the database using the SQL command select data from the login table according to the data entered in the textbox, if the data is not found then the program will display a warning through a message box that says 'wrong username and password', if the data entered is correct then the program will switch to the main menu form and close the login menu form.

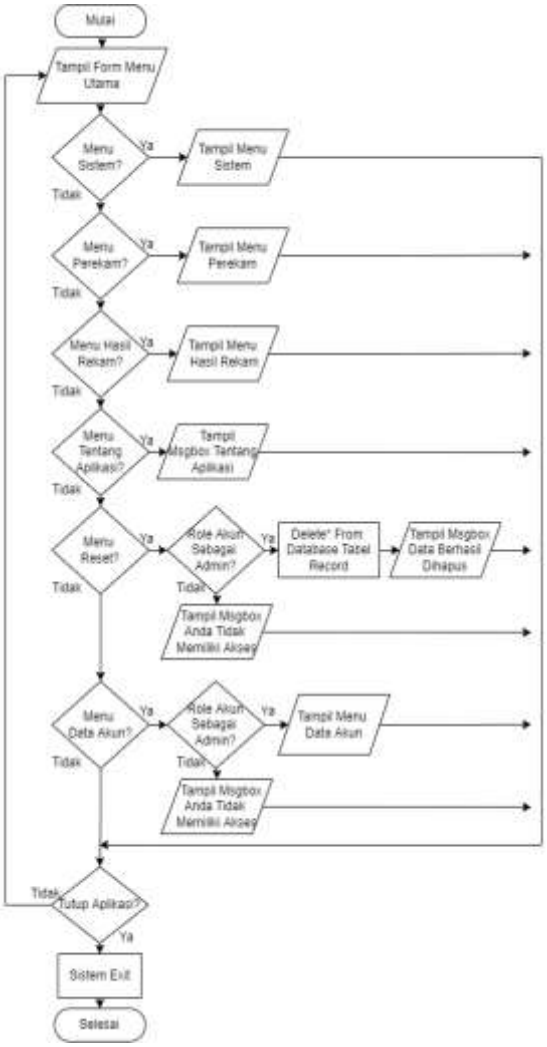

Figure 3. Main Menu Flowchart

After successful login the programme will direct the user to the main menu where the display on the page has a text status strip user name according to the login account. On the main menu there are several options including: (1) System menu: In the system menu there are options to take action to close the application and log out the account to return to the login account. (2) Recorder menu: When the user takes action on the recorder menu button, the programme will open a form for recording. (3) Recording menu: The recording results menu button will direct users to the recording results form. (3) Menu about the application: The about application menu button will display a message box that says about the railway communication recorder application. (4) Reset menu: The reset menu button will delete the saved recording results, only users with the admin role can run the reset menu, if the user's role is not an admin then the programme will display a message box that says 'You do not have access rights'. (5) Account data menu: The account data menu button will direct users to the account data

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menu form, only users with the admin role can access to the account data form, if the user's role is not an admin then the programme will display a message box that says 'You do not have access rights'.

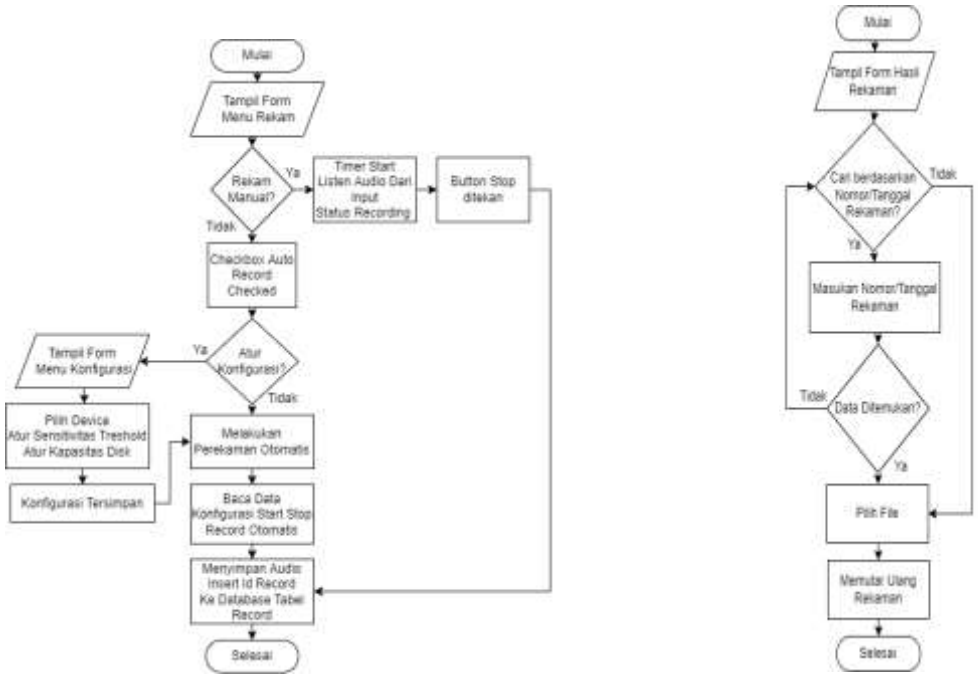

Figure 4. Flowchart (a) Recorder Menu (b) Recording Results

The recorder menu is a form used by the user to manage the recording of railway communications where the user can perform several actions such as manual recording by pressing the record button so that the application will start recording manually and the recording stops when the user presses the stop button. When pressing the stop button the programme will stop recording and save the recorded data on the disc and database. Automatic recording is done by clicking on the auto record checkbox, then if the user wants to set the configuration, they will be directed to the configuration form and can configure including the selection of the microphone device to be used, setting the threshold sensitivity of the programme in recording sound and the maximum storage capacity limit on the allocated disk. After configuring, the user can save the configuration and exit the configuration form. After the checkbox has indicated auto record, the application automatically records all langsiran communication when it gets voice input whose sound volume is greater than the specified thereshold value and will stop and save the data when the sound has stopped or the sound volume is smaller than the thereshold value.

The recording results menu, in this menu the programme will display the recorded train communication data on the data grid view, the user can play the sound that has been recorded or stored in the system. Users can also search for recordings based on the recording number or recording date. When the user performs a search, the data gridview will only display the searched data and the user can listen to the recording results. There is an exit button to close the recording results form and return to the main menu.

2.3. Testing the System

Software testing is done using the Black Box Test method. Testing the Langsiran Communication Voice Recorder desktop application system is to test whether the function of a form or buttons contained in the application can function in accordance with the coding made or a programme error occurs. The

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items in the application that will be tested are, login form, main menu, and search function as well as data filtering test results. Testing the suitability of the langsiran communication voice recorder with Ministerial Regulation NO.45 of 2018 concerning technical requirements for railway telecommunications equipment includes testing automatic recording, testing automatic deletion of previous recordings, testing alarm indicators, testing timers, and testing playback of recorded results.

3. Results and Discussion

3.1. Hardware Design

Figure 5. Interface circuit and its connection device

The interface circuit functions as a handy talky output voltage reducer that enters the PC and prevents the DC voltage that will enter the PC. Here's a picture of the interface circuit. Handy Talky has a voltage output of 1 VAC, while the PC is only able to receive a voltage of 20 mVAC. Therefore the author makes an interface circuit, which serves to reduce the voltage of 1 VAC to 20 mVAC by using 3 resistors in series with a resistance value of 5, 1 KΩ. Meanwhile, to prevent the incoming DC voltage the author uses a capacitor. In this circuit, a 2.2 µF capacitor is used in series with a 2.2 µF capacitor and a capacity value of 1 µF is obtained to prevent DC voltage from entering the PC. The langsiran communication voice recorder application that has been made is installed on an Asus laptop and connected to a handy talky through an interface circuit using a 3.5 mm audio jack as shown above.

3.2. Software Design

The database is created by grouping the main data needed to run the application. The result of creating the application database is the ‘Recorderdb’ database and the table names are ‘login’, ‘record’, and ‘configuration’.

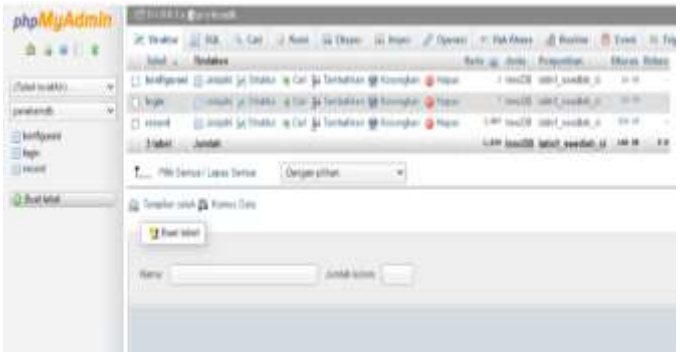

Figure 6. Data Base Application

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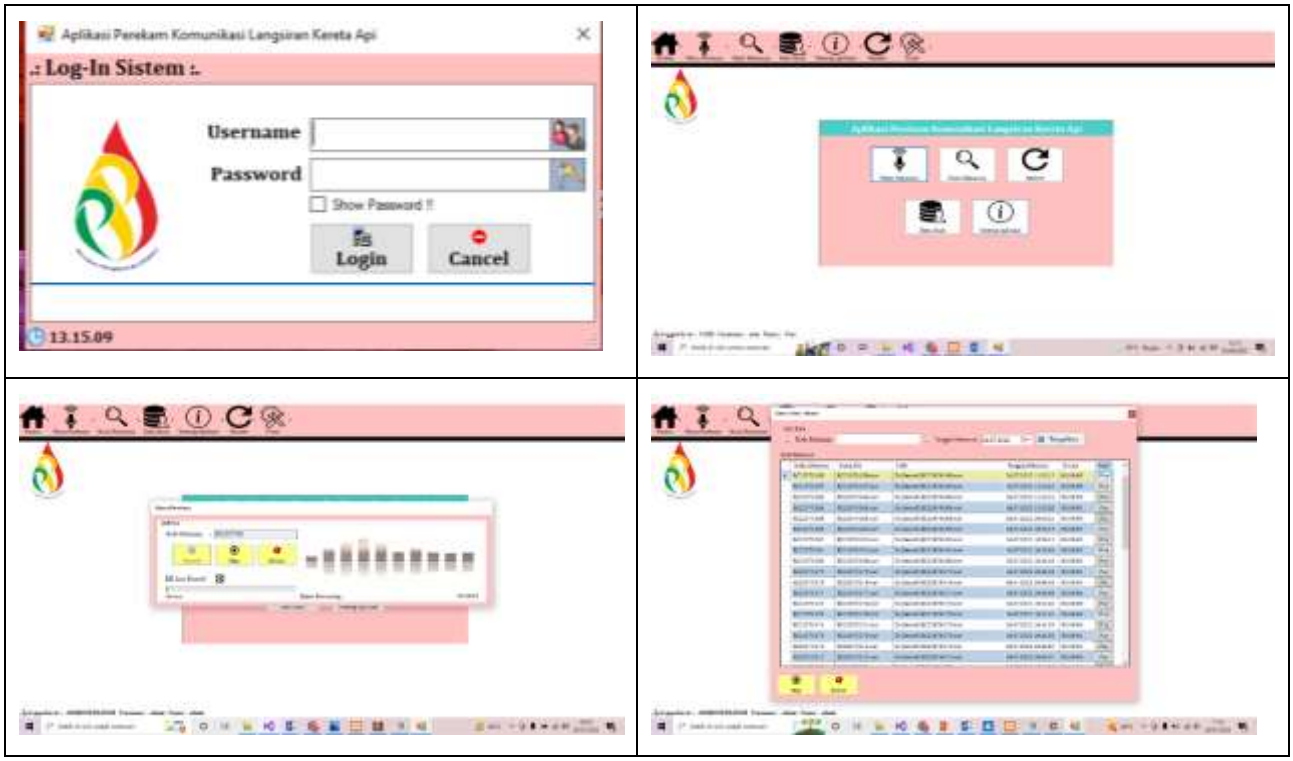

Figure 7. (a) Login Form (b) Main Menu Form (c) Recorder Menu Form (d) Record Results Menu Form

Application Login Form is a process to enter a service that contains a username and password. In the langsiran communication voice recorder application, the login page is used to secure the system and data contained in the langsiran communication voice recorder application. The login process is the entrance process for users to access the system from the application.

The main menu form is the main page display of the langsiran communication voice recorder application. The main page is the part that serves to display the langsiran communication voice recorder menu menu, users can select the desired menu through the buttons provided including the recording page, recording results page, restart page, account data, page about the application, and logout button.

Recorder menu form, before recording the user must first connect the system by clicking the scan button, then select the port, and click the connect button. After connecting the application will automatically record conversations that occur on the handy talky and display real-time recording results.

Record Results Menu Form, on the recording results data page, there are several widgets, namely the recording results table which contains several columns (Number, recording code, file name, recording storage, recording date, recording time, duration and can be played), and the recording data search form which can be filled in to facilitate the search for past data recording results. In the data search form, there are several labels to speed up the data search process both based on the recording code and recording date. To prevent errors in the data search process, when entering the data sought must be filled in correctly.

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3.3. Software

From the results of the software design, testing is carried out to ensure that the tool can be used properly as shown in Figure 8.

Akun		Kondisi	Tampilan Aplikasi	HASIL
Username	*Password*			
admin	admin	*Username* dan *Password* Benar	Berhasil *Login*	Sesuai
		Username dan *Password* Salah	Tidak Berhasil *Login* tampil "*Username* tidak ditemukan, silahkan *registrasi*! "	Sesuai
		Username benar dan *Password* salah	Tidak Berhasil *Login*, tampil "*Login* gagal, *check Username and Password*!"	Sesuai
		Username salah dan *Password* benar	Tidak Berhasil *Login* tampil "*Username* tidak ditemukan, silahkan *registrasi*! "	Sesuai
user	user	*Username* dan *Password* Salah	Tidak Berhasil *Login* tampil "*Username* tidak ditemukan, silahkan *registrasi*! "	Sesuai
		Username benar dan *Password* salah	Tidak Berhasil *Login*, tampil "*Login* gagal, *check*	Sesuai

No.	input	Output	Percobaan	hasil
1.	Klik ikon rekaman	Menampilkan menu rekaman	10 kali	Berhasil
			-	Gagal
2.	Klik ikon hasil rekam	Menampilkan menu hasil rekaman	10 kali	Berhasil
			-	Gagal
3.	Klik ikon restart	Menampilkan pesan "Anda yakin data rekaman akan dihapus?"	10 kali	Berhasil
			-	Gagal
4.	Klik ikon data akun	Menampilkan menu data akun	10 kali	Berhasil
			-	Gagal
5.	Klik ikon tentang aplikasi	Menampilkan pesan " Aplikasi perekam komunikasi langsiran kereta api"	10 kali	Berhasil
			-	Gagal

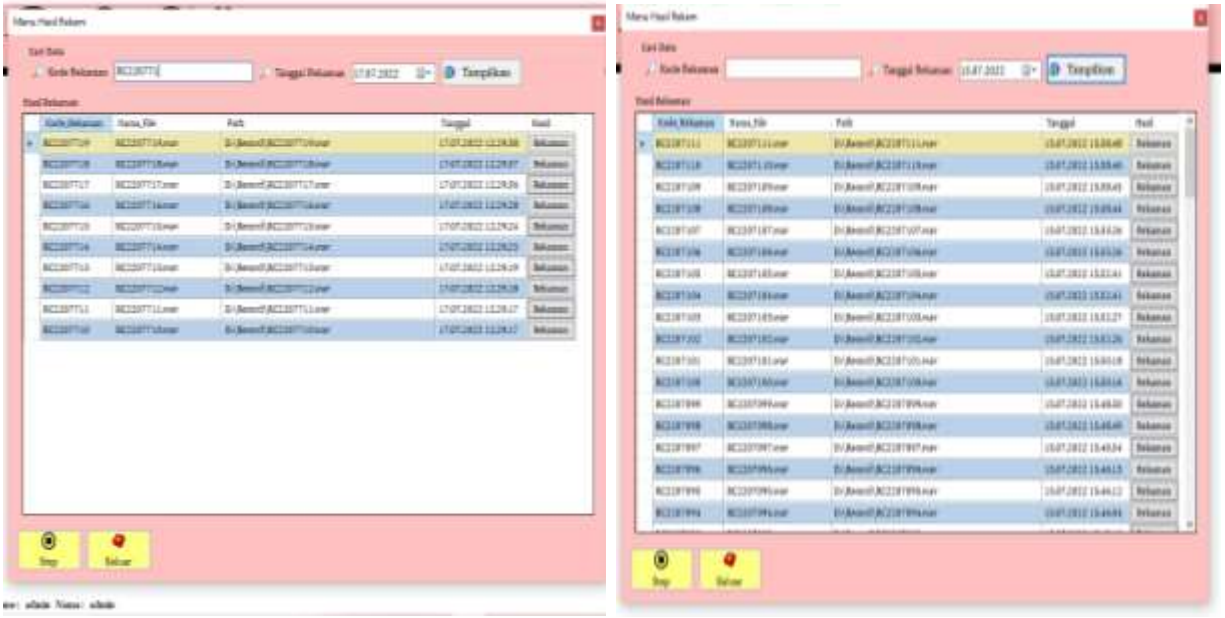

Figure 8. Testing Results (a) Login menu (b) Main Menu (c) data search menu based on record code (d) data search menu based on record date

Shows the results of several software tests which include (1) testing the login form function, after experimenting with seven usernames and passwords that have been registered with each of 10 (ten) trials with 4 (four) conditions, the results obtained from the test show that the login form can function according to design and there are no failures. (2) Testing the main menu function, of the 5 (five) buttons on the main menu and carried out in ten trials of the button function. The results obtained are that the five buttons on the main menu did not fail in ten trials. (3) Selecting data based on the recording code, selecting data based on the recording code by typing the text in the recording code box, then searching for data based on the desired recording code. The test was conducted by

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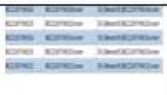
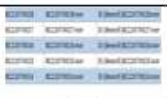
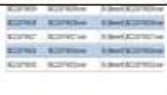
searching for the record code 'RC220788'. A screenshot during the test of selecting records by record code is as follows. (4) Selecting recordings by date, selecting recordings based on the recording date is done by selecting the date on the available menu without having to type the date, after the date is selected the user must press the 'Show' button, if the user does not press the 'Show' button then the recordings that have been selected by date will not appear. Screenshot during testing of selecting recordings based on recording date.

No.	Kondisi	Tampilan Aplikasi	Yang terjadi	Hasil
1.	Terdapat suara		Mulai melakukan rekaman	Sesuai
2.	Tidak ada suara		Berhenti melakukan rekaman	Sesuai
3.	Terdapat suara		Mulai melakukan rekaman	Sesuai
4.	Tidak ada suara		Berhenti melakukan rekaman	Sesuai
5.	Terdapat suara		Mulai melakukan rekaman	Sesuai
6.	Tidak ada suara		Berhenti melakukan rekaman	Sesuai

No.	Parameter Uji	Indikator keberhasilan sistem	Hasil
1	Pengujian login saat belum terkoneksi	Menampilkan pesan " Sistem Tidak Terkoneksi"	
2	Username dan password belum terisi	Menampilkan pesan " Masukan Username"	
3	Username atau password salah	Menampilkan pesan " Login gagal, check username and password!"	

Percobaan	Input	output	Hasil
1			Sesuai
2			Sesuai
3			Sesuai
4			Sesuai
5			Sesuai
6			Sesuai
7			Sesuai

No.	Detik ke	Gambar	selisih
1	5		1 detik lebih cepat
2	10		1 detik lebih cepat
3	15		1 detik lebih cepat
4	20		1 detik lebih cepat
5	25		1 detik lebih cepat

Figure 9. Test Results (a) Auto Recording (b) Auto Erase (c) Alarm Indicator (d) Timer Testing

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Several software tests were conducted to evaluate the application's performance in terms of automatic recording, automatic deletion, alarm indicators, and timer accuracy, as shown in Figure 9. First, the automatic recording feature was tested with 20 samples (Table 4.3), and 19 trials were successfully detected according to the system's conditions. One trial failed because the user's voice was too low for the system to detect, indicating that the application's sensitivity needs improvement. This yielded an accuracy rate of 95%, with the 5% error attributed to low sound levels and insufficient sensitivity. Second, the automatic deletion feature was verified to function correctly. The system automatically deleted the oldest records when storage fell below the specified limit, with deletions occurring every minute. Third, the alarm indicator was tested for its reliability during interference. Six test parameters were evaluated across 10 trials, and no failures occurred, confirming the alarm's 100% reliability in signaling disruptions. Fourth, the timer feature was tested by comparing the application's timer to the world clock over 10 observations. The application consistently displayed a time 1 second faster than the world clock, suggesting minor calibration adjustments may be necessary. Additionally, while the application effectively displays the start time of recordings and allows unlimited playback of stored recordings, it does not show the stop time. To determine the recording duration, users must manually observe the playback. Although functional overall, improvements in sensitivity, timer accuracy, and the display of start and stop times would enhance the application's utility. Overall, these tests demonstrate that the system is largely effective for monitoring shunting communications, with minor enhancements needed to further improve its functionality and reliability.

Tabel 3. NodeMCU ESP8266 Module Testing Data With Barrier

No.	With Barrier	
	Distance (m)	Transmitter and Receiver Communication
1	0	Connected
2	2	Connected
3	4	Connected
4	10	Connected
5	15	Connected
6	25	Connected
7	50	Connected
8	70	Connected
9	100	Connected
10	130	Connected
11	160	Connected
12	170	Disconnected

3.4. Data Analysis

The test will be carried out by monitoring the temperature and vibration of the electric motor and observing whether the sensor can work properly or not. If it works well, the sensor will send a signal to the blynk application normally. From this test, it can be seen that all components have worked well or not, with the indicator that the signal received from the LCD monitor with the blynk application is

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appropriate. This test aims to determine the performance of the sensor in monitoring temperature and vibration and after that sending data to the Blynk application. In this test the electric motor runs for 30 minutes. Therefore, the data obtained in Table 4.

Tabel 4. Thermocouple Sensor and Piezzoelctric Sensor Value Data

No.	Time (Second)	Thermocouple	Piezoelectric (m/s^2)
1	1	30,3℃	20
2	5	30,8℃	24
3	10	30,7 ℃	21
4	15	31℃	23
5	20	31,7℃	24
6	25	33,6℃	24
7	30	34,2℃	23

According to the sensor tests that have been carried out in table 4.1, it can be seen that the sensor is working properly. And according to the data that has been collected, it can be concluded that the electric motor is in poor condition because the average vibration value is 22 m / s2. Because the piezoelectric sensor unit this time is m / s2, in order to be compared with the ISO 10816 table, it must be converted to mm / s with the following formula:

$$Piezzoelectric\ (\text{mm/s}) = \frac{\sqrt{Nilai}\ Piezzoelectric\ \ x\ \ 1000}{Rpm\ Motor}$$

With the formula above and with a sensor value of 22 m / s2 and the rpm of the electric motor tested this time is 978rpm, the following values can be taken:

$$Piezzoelectric\ (\text{mm/s}) = \frac{\sqrt{Nilai}\ Piezzoelectric\ \ x\ \ 1000}{Rpm\ Motor}$$
$$= \frac{\sqrt{22}\ \ x\ \ 1000}{978}$$
$$= \frac{4{,}69\ \ x\ \ 1000}{978}$$
$$= 4{,}8\ \text{mm/s}$$

When compared to the ISO 10816 table, the vibration value of 4.8 mm/s tested on the motor in Figure 10 with the Small Machines Class 1 motor specification is worth 'Unsatisfactory (alert)' or means not good.

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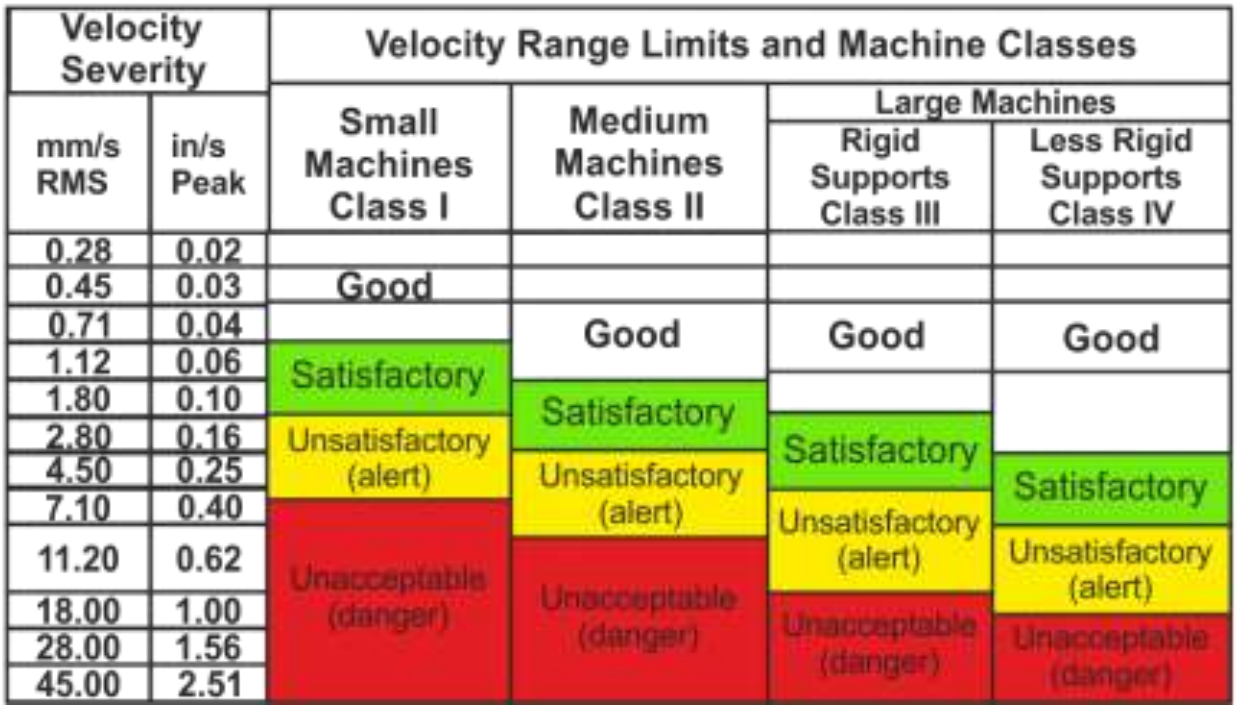

Figure 10. ISO10816-1

4. Conclussion

Based on the process of designing the tool and the results of testing the tool that has been carried out by the author, conclusions can be drawn, namely: The design of temperature and vibration monitoring system on electric motor wirelessly using blynk application with NodeMCU ESP8266 microcontroller by utilising two sensors namely piezzoelectric sensor, and thermocouple sensor with 16x2 LCD output, and blynk application. The system can monitor the temperature and vibration of the electric motor on the ship remotely using the blynk application by connecting the thermocouple sensor and piezoelectric sensor to the NodeMCU ESP8266 module, in this test the module is connected via wifi / hotspot on a smartphone. To view remote data, you can use the Blynk application, so that the temperature and vibration of the electric motor can be monitored remotely, and the sensor is applied to the electric motor on the ship, especially in the engine room. The results of the research conducted this time with good sensor performance compared to the thermogun measuring instrument prove that the thermocouple sensor has worked well and does not need to be calibrated again. Through the data generated from sensor performance research on electric motors and the results compared to the ISO 10816 table, the value of 4.8 mm / s indicates that the state of the electric motor is not good so that repairs need to be made.

Acknowledgments

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