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Design Of A Handy Talky Voice Logger System Using A Voice Recording System Application Integrated With A Mysql Database At Nunukan Airport

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Abstract

Radio communication using a Handy Talky (HT) is an essential means of supporting operational coordination within the airport environment. However, the absence of a voice logger system capable of recording and documenting all HT communications in a structured manner can limit monitoring, operational evaluation, and incident investigation. This study aims to design a Handy Talky voice logger system using a Voice Recording System (VRS) application integrated with a MySQL database at Nunukan Airport. The research method used is ADDIE (Analysis, Design, Development, Implementation, Evaluation) combined with a Research and Development approach. The system automatically records HT communications, transmits recording metadata to a MySQL database using a Python program, and displays the data through a web-based monitoring interface. Test results show that the main functional parameters (signal reception, recording, metadata storage, time synchronization, and playback) achieved a success rate of 90-100%, with a system delay of 1.5 seconds, while design validation showed an average success rate of 96%. These results indicate that the designed system is functionally feasible and able to support operational communications documentation in accordance with PM 2 of 2026 and ICAO Annex 10 Volume II.

Keywords: Handy Talky, MySQL, Python, Voice logger, Voice Recording System

INTRODUCTION

Aviation safety is a fundamental aspect of air transportation operations because it directly relates to the protection of human life, the continuity of airport operations, and public trust in aviation services. The increasingly complex development of the aviation industry demands that every aviation service provider implement an integrated, systematic, and well-documented safety system. One critical component of implementing a Safety Management System (SMS) is the availability of a safety information reporting and documentation system capable of supporting hazard identification, risk analysis, and investigation of every operational incident.(Misbakhudin & Prapanca, 2023);(Ramadhan et al., 2025). The Indonesian government, through Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 2 of 2026, requires all aviation service providers to provide a safety reporting system and ensure the availability of accurate, documented, and traceable safety data as part of the implementation of the Safety Management System (Ministry of Transportation of the Republic of Indonesia, 2026). Thus, the management of operational communication information is an integral part of efforts to improve safety culture within the airport environment.(Reader & Gillespie, 2025).

In airport operations, communication via Handy Talky (HT) is the main media used by various work units, such as Aviation Security (Avsec), apron officers, technicians, Airport Rescue and Fire Fighting (ARFF), and other operational units in carrying out coordination quickly and in real-time. The time-critical and safety-critical characteristics of flight operations cause every instruction, confirmation, or delivery of information via HT to have direct consequences for flight safety. Communication errors, loss of information, or the unavailability of communication documentation have the potential to cause delays in handling incidents, coordination errors, and even increase the risk of operational incidents. Therefore, radio communication documentation is an important element in supporting the effectiveness of the Safety Management System and evidence-based decision making (International Civil Aviation Organization [ICAO].

Internationally, ICAO, through Annex 10 Volume II of Aeronautical Telecommunications, stipulates that aviation communication systems must be supported by voice communication recording facilities that are capable of recording communications continuously, operating in real time, and storing data securely and can be traced back if necessary for investigations or operational evaluations. This provision shows that communication recordings are not merely administrative archives, but rather part of the aviation safety system that supports the investigation process, organizational learning, and improving the quality of service. This practice is also applied to the Cockpit Voice Recorder (CVR), which has proven to be one of the main sources of information in identifying the cause of an accident and reconstructing the chronology of events objectively.(Chen, 2026)However, the implementation of communication recording systems for HT-based ground operational communications at many airports is still not optimal.(Rahmadani et al., 2022).

This phenomenon was also found at Nunukan Airport. Based on initial observations, operational communication between officers is still conducted using conventional HTs without the support of a voice logger system that can automatically record all conversations. This condition results in the unavailability of communication recordings when operational incidents occur, difficulties in evaluating the coordination process between units, limited objective data in assessing officer performance, and weak evidence in the event of a communication dispute (operational dispute). In fact, communication documentation is one form of safety data required in the implementation of the Safety Management System according to national regulations and ICAO standards (Ministry of Transportation of the Republic of Indonesia, 2026; ICAO, 2016). This phenomenon indicates a gap between regulatory demands and implementation conditions in the field.

This issue is becoming increasingly important given that digital transformation in the air transportation sector is driving all operational processes to be data-driven. Manual or even undocumented communication documentation systems result in missed opportunities for analyzing communication trends, identifying the causes of coordination errors, conducting safety audits, and conducting continuous organizational learning. From a safety management perspective, communication data is a valuable source of information for hazard identification, risk assessment, and continuous safety improvement. Therefore, developing a voice logger system capable of automatically recording, storing, managing, and tracking communications is an urgent need for airport managers.

Based on previous research, various studies have successfully developed Handy Talky-based communication recording systems and digital voice recording systems using Visual Basic, Arduino, and other microcontrollers (Dwi et al., 2021; Marselinus, 2016). Other studies have also shown that data logger technology can improve the efficiency of automatic and real-time data recording.(Haris & Putra, 2017); Effendi et al., 2025). However, most of these studies are still oriented towards voice recording functions without integrating metadata management, structured database systems, timestamp-based recording searches, web-based monitoring, or implementation in airport operational environments with high safety characteristics. Thus, there is still a research gap that needs to be filled through the development of a more comprehensive system.

Based on these gaps, this research offers a novelty in the form of developing a voice logger system for HT communication using the Voice Recording System (VRS) application integrated with the Python programming language, MySQL database, and a web-based monitoring system. This integration enables automatic recording processes, timestamp-based metadata storage, fast data retrieval, real-time monitoring of communication activities, and more effective digital archive management. In addition to meeting the needs of operational communication documentation, the developed system is also designed with reference to Data Acquisition principles so that it is able to maintain signal quality, data integrity, and the sustainability of communication information storage as part of the implementation of the Safety Management System.(Zhai et al., 2026). Based on the description, it can be concluded that the unavailability of an integrated voice logger system in HT communications at Nunukan Airport is a problem that has implications for safety aspects, operational documentation, and compliance with national and international aviation regulations.

RESEARCH METHODS

This research uses the ADDIE (Analysis, Design, Development, Implementation, Evaluation) method with a Research and Development (R&D) approach. The ADDIE model was chosen because it has...stagessystematic and structured in developing application-based systems, thus facilitating the process of designing, developing, and evaluating voice logger systems integrated with the MySQL database.

Table 1. Research Stages with the ADDIE Approach

Stage	Main Activities
Analysis	Problem identification, system requirements analysis, data and literature collection, development objective determination
Design	Designing system architecture, flowcharts, databases, interfaces (UI), and system specifications
Development	System development, hardware-software integration, voice logger application creation, connection to MySQL, internal testing
Implementation	Operating the system in a simulated environment, observing performance, collecting feedback
Evaluation	Black box testing, system suitability evaluation, results analysis, improvement recommendations

During the analysis phase, HT usage at Nunukan Airport ranged from 2 to 10 active units per day on the same frequency channel. Because HT communication is half-duplex, the system only receives one active transmission at a time, so recording capacity is not limited by the number of HTs but by the frequency channel, communication duration, and server storage capacity. Assuming an operational duration of 10 hours/day and an audio bitrate of 64 kbps, the system is estimated to require approximately 288 MB of storage capacity per day or 8.6 GB per month.

In the design stage, the system was built from the hardware side in the form of HT, additional HT receiver, 3.5 mm TRS audio jack cable, laptop with minimum 4 GB RAM, and sound card as analog to digital signal converter. From the software side, the system uses Voice Recording System (VRS) application for automatic recording, Python for integration of recording files to database, MySQL for metadata storage, PHP for web-based monitoring interface, and XAMPP as local server. Component details are presented in Table 3 and Table 2.

Table 2. Hardware Components

No	Component	Specification	Function
1	Handy Talky (HT)	UHF 403-470 MHz	Operational communication
2	HT Receiver	1 additional unit	Capture communication
3	Jack Cable	3.5mm TRS	Audio transmission
4	Laptop	RAM ≥ 4 GB	Data processing
5	Sound Card	Internal	ADC (analog to digital)

Table 3. Software Components

No	Software	Function
1	Voice Recording System (VRS)	Automatic audio recording
2	Python	File integration to database
3	MySQL	Metadata storage
4	PHP	Web-based monitoring
5	XAMPP	Local server

Table 4. System Design Parameters

Parameter	Mark
Number of HT	≤ 10 units
Frequency	1 channel
Bitrate	64 kbps
Recording duration	8-12 hours
Storage	≥ 30 days

Table 5. Record Data Structure in MySQL Database

Field	Data Type	Information
id	INT	Primary key
file_name	VARCHAR	Audio file name
record_time	DATETIME	Recording timestamp
duration	INT	Recording duration (seconds)
channel	VARCHAR	Communication channels
file_location	TEXT	File storage path

The system workflow is designed starting from the HT audio source, forwarded via an audio interface/jack cable to the computer, processed by the VRS application for automatic recording and timestamp-based file naming, stored in MP3 format on storage media, then the recording metadata is sent by the Python program to the MySQL database, and finally displayed on the web interface for the needs of searching, monitoring, and playback of recordings. The system architecture and workflow are depicted in Figure 1 and Figure 2.

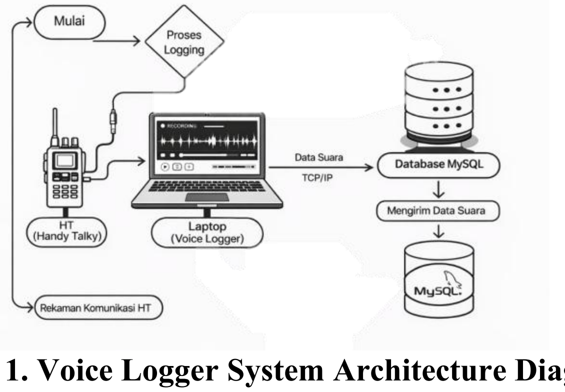

Figure 1. Voice Logger System Architecture Diagram

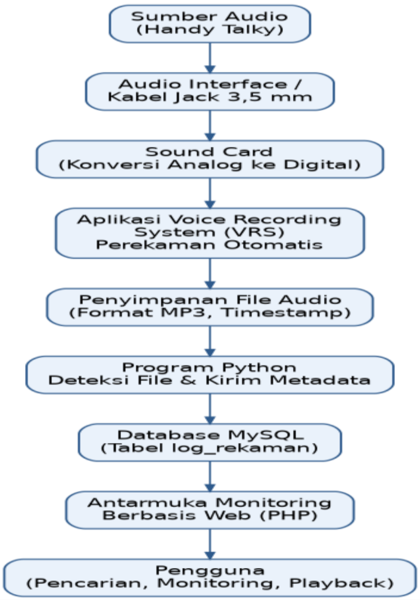

Figure 2. Voice Logger System Workflow Flowchart

The web-based system interface design is made so that users can search and monitor recorded data easily, as shown in Figure 3.

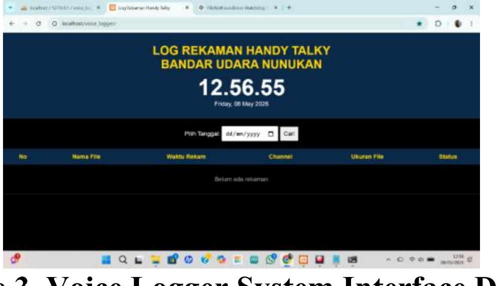

Figure 3. Voice Logger System Interface Design

System testing was conducted using a black box testing approach to determine the suitability of the system functions to the design. The parameters tested included signal reception, voice recording, data storage, time synchronization, multi-HT capability, system stability, playback, and system delay. The test success rate was calculated by comparing the number of successful trials to the total number of trials, and the system was declared feasible if it achieved a minimum success rate of 90% for implementation testing and 85% for design validation. The complete testing procedure is shown in Figure 6. The research was conducted in the operational environment of the HT communication office of the Class III Nunukan Airport Operator Unit.

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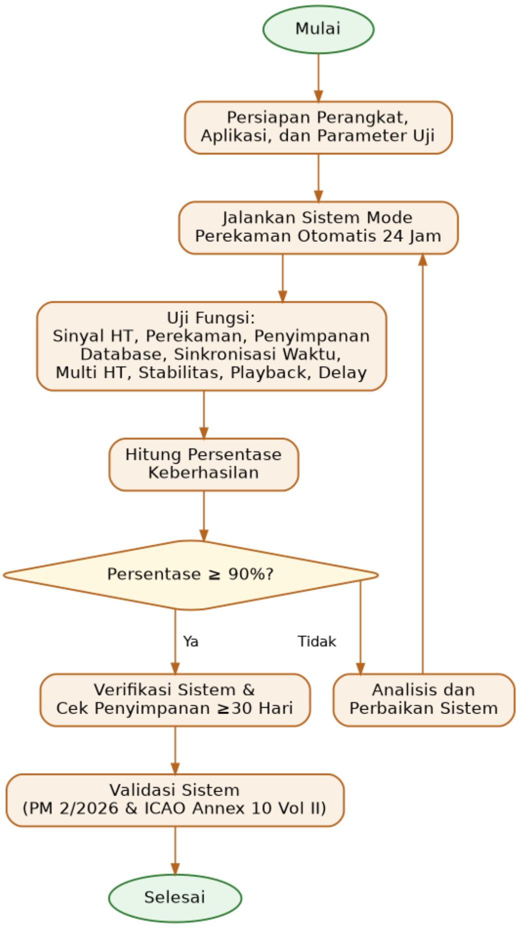

Figure 4. Flowchart of the Voice Logger System Testing Process

RESULTS AND DISCUSSION

System Overview

The designed voice logger system consists of three main parts: an input device, a processing device, and a storage device. The audio signal from the HT is transmitted via a 3.5 mm audio jack cable to the computer's sound card to be converted from analog to digital. The VRS application then performs real-time recording without operator intervention and assigns a timestamp to each recorded file. In addition to generating audio files, the system manages recording metadata—file name, date and time, duration, and storage location—through a MySQL database, thus making data management more structured than storing files separately in a computer folder.

System Implementation Test Results

Implementation testing was conducted by running the system in automatic recording mode to test the functionality of HT signal reception, recording, data storage to the database, time synchronization, multi-HT capability, system stability, playback, and delay. The test results are presented in Table 5.

Table 5. Voice Logger System Implementation Test Results

Test Parameters	Number of Trials	Succeed	Percentage	Standard
HT signal reception	10	10	100%	≥90%
HT voice recording	10	9	90%	≥90%
Saving to database	10	10	100%	≥90%

Test Parameters	Number of Trials	Succeed	Percentage	Standard
Time synchronization	10	10	100%	On time
Multi HT (simultaneous)	10	9	90%	≥90%
System stability (24 hours)	10	9	90%	≥90%
Recording playback	10	10	100%	≥90%
System delay	10	-	1.5 seconds	≤2 seconds

Based on Table 5, all test parameters achieved a minimum success rate of 90%, with signal reception, data storage, time synchronization, and playback reaching 100%. The system delay was recorded at 1.5 seconds, still within the standard limit of ≤2 seconds. These results indicate that the system has met the functionality, reliability, and performance aspects as stipulated in PM 2 of 2026 and ICAO Annex 10 Volume II.

Implementatively, the recording metadata was successfully stored in a structured manner in the MySQL database via phpMyAdmin as shown in Figure 4, while the web-based monitoring interface successfully displayed the recording data in real time as shown in Figure 5 and Figure 6.

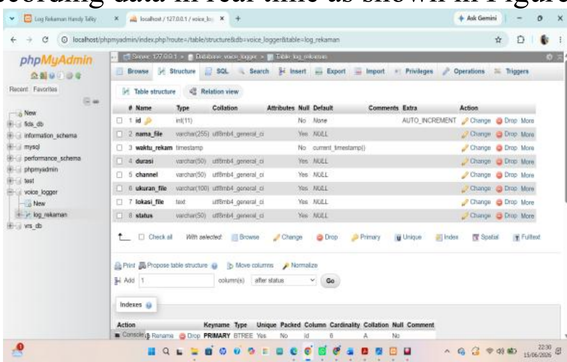

Figure 5. Implementation of the Voice Logger Database Structure in phpMyAdmin

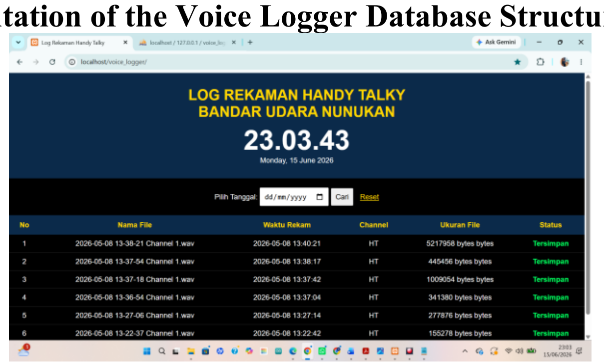

Figure 6. Web-Based Recording Data Monitoring Page

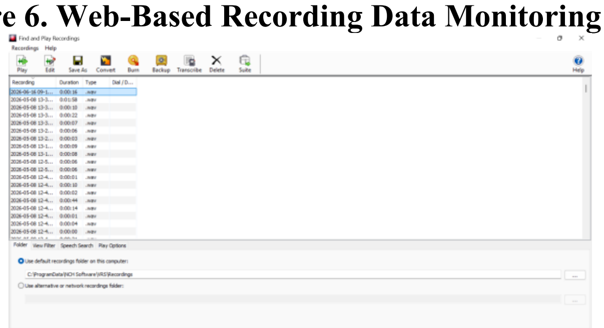

Figure 7. Display of Recording Data on the Web Interface

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Design Validation Results

Design validation was conducted internally using a black box testing approach at a simulation/laboratory scale due to limited access to the airport's operational environment. The validation results are presented in Table 8.

Table 8. System Design Validation Results

Validation Aspects	Number of Tests	Succeed	Percentage
System flow	5	5	100%
HT Recording	5	4	80%
Data storage	5	5	100%
Data access	5	5	100%
System stability	5	5	100%

The average design validation success rate reached 96%, exceeding the minimum feasibility standard of 85%. Data storage, data access, and system stability parameters showed optimal results, while HT recording experienced minor issues due to the simulation conditions. These results indicate that the system is functionally feasible, although further testing in a real operational environment is still needed to ensure performance under real-world conditions involving more devices. Interpretation of Design Results

Testing of all system modules—from HT audio acquisition, recording via VRS, file storage, metadata integration and delivery via Python, storage in a MySQL database, to monitoring and searching data via a web interface—showed "Compliant" results for all tested indicators. The Python program successfully detected new recording files automatically and sent metadata (file name, recording time, file size, and file location) to the log_recording table in the MySQL database, while the web-based monitoring interface was able to display and search recording data by date in real time. Overall, the integration between HT, VRS application, Python, MySQL, and the web-based monitoring system was proven to run as designed, so that the voice logger system can support the needs of documentation, monitoring, evaluation, and investigation of operational communications at Nunukan Airport.

CONCLUSION

Based on the design, implementation, and testing results, the Handy Talky voice logger system using the Voice Recording System application integrated with the MySQL database was successfully developed and is capable of recording HT communications automatically and continuously. The system successfully integrates the Voice Recording System application, Python program, MySQL database, and web-based monitoring system so that the recording, storage, processing, and search of recorded data can be done centrally. The developed Python program is able to detect new recording files and send metadata automatically to the database, while the web interface provides a recording search facility by date and a replay feature to support operational documentation and evaluation.

The test results show that all the main functions of the system have run well and meet the functional requirements that have been designed. The system also has a fast response time and obtained validation results that indicate that the developed design is feasible to be implemented. For further development, it is recommended to add cloud-based storage media as data backup, develop a feature for playing recordings directly through a web page, improve recording capabilities on several communication frequencies, add automatic notifications in the event of a system disruption, and carry out testing in a real operational environment with a longer period to ensure the reliability, stability, and effectiveness of the system on an ongoing basis.

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