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Development of an Automated Image and Data Processing System for Client Feedback Analysis: A Case Study of the Laguna State Polytechnic University

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ABSTRACT

The use of a manual, paper-based process for gathering and analyzing client feedback requires the Management Information Systems (MIS) office to sort, encode, and interpret each form, which often leads to delays, inconsistencies, and a high risk of human error. As feedback volume increases, the manual workflow becomes less efficient and slows an institution's ability to respond and make timely decisions. To address this, the study developed an automated image and data processing system for client feedback analysis at Laguna State Polytechnic University – San Pablo City Campus (LSPU-SPCC) to improve accuracy and efficiency. Using the Agile methodology, the system was developed through requirement gathering, design, development, and continuous testing. Technologies such as Flutter SDK, Dart SDK, Android Studio/Android SDK, Java, Kotlin, Gradle, Google MLKit, TensorFlow Lite, SyncFusion Widget, Camera Plugin, Image Processing Library, Permission Handler, Path Provider, Share plus OpenFile X, and CSV Library enabled mobile scanning, automated data extraction, sentiment analysis, and Excel report generation. The evaluation involved eight (8) respondents and a dataset of 150 scanned test forms. Quantitative results confirmed reliable system performance, achieving a 96.4% OCR character accuracy rate, a sentiment classification F1-score of 0.91, and an average processing time of 2.5 seconds per form. Furthermore, the ISO/IEC 25010 evaluation yielded an overall weighted mean score of 4.39, indicating a very good software quality.

Overall, the system served as a highly effective prototype that enhanced feedback processing, reduced errors, and supported faster decision-making.

Keywords: *automated image and data processing system, feedback, mobile scanning, agile methodology, OCR extraction*

Introduction

In the current digital era, academic institutions must continuously improve their services and maintain client satisfaction to meet the growing demands of students, faculty, staff, and other stakeholders. Client Feedback Analysis is the systematic process of collecting, categorizing, and evaluating responses from surveys to accurately assess client satisfaction and identify critical areas for service improvement. It is an essential part of service quality assurance and institutional development. Client surveys serve as a primary tool for understanding the needs and expectations of stakeholders; however, processing these feedback forms manually often leads to human errors, delayed analysis, and missed opportunities for academic service improvements.

To address these challenges, this research project was proposed. This system was designed specifically for an academic setting and aimed to streamline the entire client survey process by automating the collection, image processing, and data analysis of feedback forms. Through the integration of Optical Character Recognition (OCR), image pre-processing techniques, and automated data computations, the system can generate real-time insights that enable administrators to make faster, evidence-based decisions for improving institutional services.

Furthermore, several previous studies have laid the groundwork for developing automated feedback analysis systems in academic environments, providing valuable guidance for this research project. For instance, Smith et al. (2022), in their study, demonstrated how the combination of sentiment analysis and OCR greatly improved the speed and accuracy of processing student feedback. Their findings highlighted how automation can help educational institutions respond faster to client needs and enhance administrative efficiency. To further support the necessity of digitizing feedback mechanisms, Marshanda et al. (2024) highlighted the efficiency gains of applying OCR systems to the digitization of paper-based customer feedback documents, noting significant improvements in data processing speeds. Similarly, Iqbal et al. (2023) and Bhimavarapu (2025) recognized that utilizing advanced OCR and data processing techniques for feedback analysis dramatically enhances overall customer engagement and service satisfaction by providing rapid, actionable insights.

While existing literature has given importance to the use of automation in educational settings, a clear research gap remains regarding comprehensive systems tailored for offline and mobile-based campus environments. Most existing Optical Character Recognition (OCR) feedback systems rely heavily on cloud-based processing or do not integrate automated sentiment analysis and structured Excel reporting into a single, cohesive workflow. The primary novelty of this study was in its contribution to a fully integrated, offline mobile institutional feedback workflow that applies on-device OCR and sentiment analysis specifically tailored for structured campus client feedback forms.

Moreover, despite the numerous advantages of automation, this study also

anticipated certain challenges. One significant concern involved the quality of scanned client surveys. Issues such as blurry images, poor lighting, skewed document angles, and incomplete captures may reduce the accuracy of OCR and hinder proper data extraction. The adoption of mobile phone scanner technologies became increasingly viable to overcome these technical barriers, as evaluated by Permana et al. (2020).

Furthermore, integrating advanced layout features and text analysis for scanned documents, as supported by the findings of Ha and Horák (2022) and Abdallah et al. (2024), provides a proven foundation for extracting structured information even from complex or imperfectly scanned forms. To address this in the local context, the system incorporated advanced image pre-processing techniques designed to improve recognition accuracy and ensure reliable analysis of feedback collected within the academic institution. In addition, the system utilized a pre-trained TensorFlow Lite model for sentiment classification; however, there are notable limitations when applied to the local context, as in the Philippines, student feedback frequently incorporates local slang, mixed languages (e.g., "Taglish"), and context-specific colloquialisms, which can challenge and occasionally lower the classification accuracy of generic pre-trained models.

Lastly, this project sought to improve administrative services, automate feedback management, and support the institution's continuous improvement culture by leveraging image processing and data automation technologies specifically tailored for academic environments as embedded in the primary objectives of this study. This research project automated the extraction of data from client feedback forms using OCR to eliminate manual encoding; integrated automated sentiment analysis to categorize textual feedback; and generated immediate, structured Excel reports equipped with automated data computations to expedite the administrative workflow at LSPU-SPCC MIS.

Methods

Research Design

This study employed a descriptive-developmental research design. The developmental component focused on the design, development, implementation, and evaluation of an Automated Image and Data Processing System for Client Feedback Analysis at Laguna State Polytechnic University – San Pablo City Campus (LSPU–SPCC) under the supervision of the Management Information Systems (MIS) office. This research design was appropriate since the study involved both system development and the assessment of its effectiveness in automating feedback data extraction and analysis.

Moreover, the system was developed using the Agile software development methodology, allowing iterative development, continuous testing, and regular feedback from MIS personnel. Agile was selected to support flexibility in enhancing system features such as image scanning, image preprocessing, Optical Character Recognition (OCR), automated data extraction, sentiment analysis, and report generation. The development process followed the phases of requirements gathering, system design, development, testing, deployment, and review.

Furthermore, the hardware architecture relies on Android-based mobile devices equipped with a minimum of eight (8) megapixel (MP) cameras, while the software architecture was built on the Flutter SDK. The image processing flow begins with image capture, followed by image preprocessing techniques including grayscale conversion, noise reduction, and contrast enhancement to optimize the document for extraction. The preprocessed image was fed into Google ML Kit for OCR field-level data extraction,

while textual comments were routed to the TensorFlow Lite model for sentiment analysis. The final process flow compiled the extracted data and sentiment scores into a structured CSV/Excel format using Syncfusion libraries. The technical evaluation dataset consisted of 150 diverse client feedback forms featuring varying image conditions (e.g., optimal lighting, shadows, slight blur) to rigorously test the OCR evaluation metrics and ground-truth labeling accuracy.

During the requirements gathering phase, consultations and interviews were conducted with MIS personnel to identify issues in the existing manual feedback processing workflow, which include time-consuming data encoding, delayed analysis, and data inconsistencies. The system design phase involved the preparation of data flow diagrams, use case diagrams, and interface prototypes to define the structure and functionality of the system. The development phase focused on implementing image and data processing features using Google ML Kit for OCR and form recognition, TensorFlow Lite for on-device sentiment analysis, and Flutter SDK for the mobile application interface. Image preprocessing techniques such as grayscale conversion, noise reduction, and contrast enhancement were applied to improve OCR accuracy.

The descriptive component of the research involved evaluating the developed system based on its functionality, performance efficiency, usability, reliability, and security using the ISO/IEC 25010 Software Quality Model. The system's output included automatically generated Excel-based reports, which summarized extracted feedback data, sentiment results, and statistical summaries for administrative review. Evaluation was conducted by MIS personnel and selected IT experts to determine the system's effectiveness, accuracy, and suitability for operational use.

Taken together, this research design enabled the researchers to develop a reliable and efficient automated image and data processing system and to objectively evaluate its quality and performance, ensuring that the system meets the operational requirements of the MIS office and supports data-driven decision-making at LSPU–SPCC.

Participants of the Study

The respondents of the study consisted of eight (8) individuals, composed of four (4) system users, three (3) external IT expert testers, and one (1) MIS administrator who served as the main tester. While this is a small sample size, existing literature on usability testing (e.g., Nielsen, 2000; Hwang & Salvendy, 2010) supports that a small group of domain experts, specifically IT professionals and MIS administrators, was sufficient to reveal the vast majority of usability and functional flaws during experimental prototype evaluations.

Locale of the Study

The study was conducted at Laguna State Polytechnic University – San Pablo City Campus (LSPU–SPCC), specifically within the Management Information Systems (MIS) office, where client feedback data are collected, processed, and managed. The locale was selected because the campus primarily relies on manual handling and encoding of client feedback forms, resulting in time-consuming processing, delayed analysis, and possible data inconsistencies. This setting provided an appropriate environment for evaluating the effectiveness of the automated image and data processing system for client feedback analysis, as it allowed the researchers to assess how image scanning, OCR-based data extraction, automated data processing, and Excel-based report generation can improve the efficiency, accuracy, and timeliness of feedback analysis within the institution.

Research Instruments

The system was evaluated using a modified ISO/IEC 25010 Software Quality Model questionnaire. Based on standard software engineering principles, the quality characteristics were properly categorized to ensure rigorous evaluation.

Table 1. Corrected ISO/IEC 25010-Based Survey Questionnaire Structure

Quality Characteristic	Sub-Characteristic	Item No.	Sample Statement
Functional Stability	Functionality	1	Covers all the specified tasks and user objectives.
	Correctness	2	Provides the correct results with the needed precision.
	Appropriateness	3	Facilitates the accomplishment of tasks and objectives.
Reliability	Maturity	4	Meets reliability under normal operation.
	Availability	5	Operational and accessible when required.
	Fault Tolerance	6	Operates as intended despite faults.
	Recoverability	7	The system can recover data after interruptions.
	Adaptability	8	Can be adapted for different/ evolving hardware.
Usability	Operability	9	Easy to operate and control.
	User Error Protection	10	Protect users from making errors.
	User Interface Aesthetics	11	Provides pleasing interactions.
	Accessibility	12	Usable by a wide range of people.
Performance Efficiency	Time–Behavior	13	Response and processing time meet requirements.
	Reusability	14	Assets can be reused in other systems.
	Analyzability	15	The impact of intended changes can be assessed.
	Modifiability	16	Can be modified without defects.
	Testability	17	Test criteria can be established.

Data Collection Procedure

Data collection was carried out after the successful development and deployment of the automated image and data processing system for client feedback analysis. Prior to evaluation, the system underwent a series of structured testing phases, including unit testing, system testing, performance testing, accuracy testing, and error handling testing to ensure that all features operated correctly and met the system requirements. These testing procedures verified the reliability of image scanning, OCR-based data extraction, automated data processing, sentiment analysis, and Excel-based report generation before collecting evaluation data from the respondents.

Functionality Testing

Functionality testing for the automated image and data processing system for client feedback analysis is a crucial process aimed at ensuring that all components of the system operate as intended and align with user needs and expectations, as guided by ISO/IEC 25010 standards. This testing involved a thorough evaluation of the system's features, including user authentication to secure access, the accuracy of data entry, the verification processes for client feedback, as well as the reliable generation of insightful reports based on the analyzed data.

Furthermore, since the system incorporated different user roles, such as administrators and feedback analysts, the functionality testing confirmed that role-based access control was properly implemented, allowing each user group to interact only with the features relevant to their responsibilities. To achieve comprehensive coverage, various types of functional testing were employed.

Table 2. Unit Testing

Test Case	Test Steps	Expected Results	Status
Verify the Image Upload Module	1. Upload an image containing client feedback. 2. Submit.	The image is successfully uploaded and stored temporarily.	Passed/Failed
Validate Feedback Extraction	1. Upload an image. 2. The system extracts text from an image.	The system successfully extracts the text from the image.	Passed/Failed
Verify the Sentiment Analysis Module	1. Process extracted feedback. 2. Analyze sentiment.	System correctly classifies sentiment (positive/negative /neutral).	Passed/Failed
Validate Report Generation	1. Select report type (e.g., feedback summary). 2. Generate report.	The report is generated with accurate feedback analysis.	Passed/Failed

Table 2 presents the unit testing conducted to verify that individual components of the image-based feedback processing system function correctly before full system integration. This testing ensures that core functionalities, such as image upload, feedback extraction, sentiment analysis, and report generation, perform as expected. For example, the test case "Verify image upload module" checked whether an uploaded image was successfully stored in the system.

Similarly, "Validate feedback extraction" ensured that the system correctly extracted text from the uploaded image. The "Verify sentiment analysis module" test case evaluated whether the system accurately classifies feedback sentiment as positive, negative, or neutral. While "Validate report generation" ensured that reports are created with accurate feedback analysis.

Moreover, the last column represents the status, indicating whether each test case passed or failed. If the test passed, the expected result was successfully achieved; otherwise, it is marked as failed, indicating the need for further debugging and

improvements. Conducting unit testing at this stage allows developers to identify and resolve issues early, reducing the risk of significant errors in later development phases.

Table 3. System Testing

Test Case	Test Steps	Expected Results	Status
End-to-end Image Upload Validation	1. Upload an image containing the client feedback. 2. Submit image for processing.	The image is successfully uploaded and stored in the system.	Passed/Failed
End-to-end Feedback Extraction	1. Upload an image. 2. The system extracts text from the image.	Extracted text matches the content in the uploaded image.	Passed/Failed
End-to-end Sentiment Analysis	1. Process extracted feedback. 2. Analyze sentiment classification (positive, negative, neutral).	Feedback is correctly classified based on sentiment analysis.	Passed/Failed
End-to-end Report Generation	1. Access the reports section. 2. Generate a feedback summary report.	The report is generated with an accurate analysis.	Passed/Failed

Table 3 shows that the system testing of the automated image and data processing system for client feedback analysis administration functioned correctly from start to finish. One key test case focused on end-to-end image upload validation, where an image containing client feedback is uploaded and submitted for processing. The expected outcome is that the image is successfully stored in the system. Another test case verifies feedback extraction, ensuring that the system accurately extracts text from uploaded images.

Additionally, the sentiment analysis module is tested to confirm that the system correctly classifies feedback as positive, negative, or neutral. The report generation feature is also validated, ensuring that a summary report is generated with accurate feedback analysis. These system tests ensured the reliability of the automated feedback processing workflow, allowing the LSPU-SPCC administration to efficiently analyze client feedback, generate insightful reports, and visualize data for informed decision-making.

On the other hand, Table 4 on accuracy testing shows the evaluation of the mobile app's ability to capture correct data from survey forms. The testing included checking the detection of numerical ratings, checkbox selections, and category responses while ensuring personal information is not extracted. The expected results aim for high accuracy and consistent data extraction. The status assigned indicates whether the accuracy level meets the system's requirements. This testing is essential in guaranteeing the reliability and integrity of the extracted data.

Table 4. Accuracy Testing

Test Case	Test Steps	Expected Results	Status
Verify the extraction of numerical ratings	Use the mobile app to scan survey forms containing numerical ratings.	App accurately reads and extracts all numerical values.	Passed/Failed
Verify the extraction of checkbox responses	Scan forms with different checkbox selections using the mobile camera.	All checked boxes should be correctly detected and recorded.	Passed/Failed
Verify the extraction of categorical responses	Scan forms with varying category selections (e.g., Excellent, Good, Poor).	The app accurately identifies and extracts the correct category.	Passed/Failed
Ensure personal information is ignored	Scan forms containing optional name or contact details.	The app automatically ignores personal information fields.	Passed/Failed

Table 5 presents the performance testing results evaluating how well the mobile application performed during single and multiple form scans. It covers scanning time, responsiveness under continuous use, and export efficiency. The expected results focus on maintaining smooth performance throughout the scanning process. The status indicates whether the mobile app meets optimal performance expectations. This testing ensured the system is fast, efficient, and suitable for real-world feedback collection.

Table 5. Performance Testing

Test Case	Test Steps	Expected Results	Status
Measure scanning and extraction time for a single form	Scan one survey form using the mobile camera.	The app processes and extracts data within a few seconds.	Passed/Failed
Batch processing duration (multiple scans)	Scan 10–20 survey forms consecutively.	The app maintains consistent speed with no performance drop.	Passed/Failed
App responsiveness under continuous use	Use the app to scan forms repeatedly for 10+ minutes.	App remains responsive; no freezing or unexpected closing.	Passed/Failed
Export time to excel or summary output	Export extracted data to Excel or to an in-app summary.	The file is generated quickly and accurately.	Passed/Failed

Table 6 describes the error handling testing and how the mobile app responds to scanning issues. Test cases included blurry images, incomplete answers, wrong templates, and unreadable handwriting. The expected results ensured that the app provided appropriate error notifications, and the status indicated whether the error-handling functions worked effectively. This ensures data reliability and prevents inaccurate information from being processed.

Table 6. Error Handling Testing

Test Case	Test Steps	Expected Results	Status
Scan blurry or shaky images	Take a blurry photo of the survey form using the mobile camera.	The app notifies the user to retake the photo due to low clarity.	Passed/Failed
Scan incomplete survey forms	Scan forms with missing answers or blank sections.	App alerts the user to incomplete data or highlights missing fields.	Passed/Failed
Scan a wrong or outdated form template	Attempt to scan forms that do not match the required layout.	App displays an error indicating "Invalid Form Template."	Passed/Failed
Scan forms with unreadable handwriting	Scan forms with unclear or messy writing.	The app identifies unreadable areas or warns the user.	Passed/Failed

Analysis of Data

The data gathered from the system evaluation were analyzed using descriptive statistical techniques, primarily through the computation of mean scores for each ISO/IEC 25010 software quality characteristic and its corresponding sub-attributes. The computed values were interpreted using a five-point Likert scale, with ratings classified as Poor, Fair, Good, Very Good, and Excellent.

This method of analysis allowed the researchers to objectively evaluate the quality and performance of the automated image and data processing system for client feedback analysis, identify its strengths, and determine areas that may require enhancement to better support the operational needs of the MIS office at LSPU–SPCC. In measuring and interpreting the quantitative data gathered from the evaluation survey, the following scale was used:

Table 7. Numerical Scale of the ISO/IEC 25010

Scale	Interpretation
4.51 – 5.00	Excellent
3.51 – 4.50	Very Good
2.51 – 3.50	Good
1.51 – 2.50	Fair
1.00 – 1.50	Poor

Ethical Considerations

Ethical considerations were strictly observed throughout the conduct of the study to ensure the protection of the rights of all the participants. Before participation, respondents were informed of the purpose of the study, the procedures involved, and their right to voluntarily participate or withdraw at any time without penalty. Informed consent was obtained from all participants before data collection. Furthermore, the system's design, role-based access controls, and data filtering mechanisms adhere strictly to the Philippine Data Privacy Act of 2012 (Republic Act No. 10173) to ensure the absolute protection of every student's and client's information.

Hence, the confidentiality and anonymity of participants were maintained by ensuring that no personally identifiable information was disclosed in the survey results, analysis, or publication of findings. All collected data were used solely for academic and research purposes and were securely stored to prevent unauthorized access.

The research process was reviewed and approved by the appropriate academic and institutional authorities to ensure compliance with ethical research standards. No conflict of interest was identified during the conduct of the study. The researchers also acknowledged and respected the rights, contributions, and professional roles of all employees and IT experts who participated in the evaluation process.

Results and Discussion

This section presents the results gathered from the development, testing, and evaluation of the automated image and data processing system for client feedback analysis. The discussion emphasized the performance of the system, its features, and the outcomes of various testing procedures conducted by the researchers. These include functionality, accuracy, usability, performance, and error-handling tests, and the results demonstrated how the system successfully addressed the long-standing issues of manual survey processing at LSPU SPCC, providing a more efficient, error-free, and automated approach to client feedback management, which strongly aligns with recent literature advocating for the digitization of academic and customer feedback systems.

Testing Results

The Automated Image and Data Processing System for Client Feedback Analysis at LSPU-SPCC MIS underwent thorough testing to verify that all system components performed correctly and met the project's objectives. The evaluation focused on key areas such as functionality, accuracy of data extraction, usability of the mobile interfaces, and the overall reliability of the automated scanning and export features. Testing was conducted by three (3) external IT experts, along with the development team, to ensure that the system operated efficiently and consistently under different scenarios.

Table 8 reflects the results of the unit testing conducted on the automated image and data processing system for client feedback analysis. The table summarizes the core modules evaluated during testing, including their expected behaviors, the actual outcomes observed, and the final status of each test case. The Image Upload Module performed successfully, allowing users to upload survey images without errors. Each uploaded file was temporarily stored for processing, confirming that the system can properly handle image input, which is essential for the scanning and extraction workflow.

Table 8. Unit Testing Results

Test Case	Test Steps	Expected Results	Status
Verify the image upload module	1. Upload an image containing client feedback. 2. Submit.	The image is successfully uploaded and stored temporarily.	Passed
Validate feedback extraction	1. Upload an image. 2. The system extracts text from an image.	The system successfully extracts the text from the image.	Passed
Verify the sentiment analysis module	1. Process extracted feedback. 2. Analyze sentiment.	System correctly classifies sentiment (positive/negative /neutral).	Passed
Validate report generation	1. Select report type (e.g., feedback summary). 2. Generate report.	The report is generated with accurate feedback analysis.	Passed

Furthermore, the Feedback Extraction Module, which handles the OCR-based recognition of text from uploaded survey images, also met expectations. During testing, the system consistently extracted text from various sample forms, confirming that the OCR functionality operates accurately and reliably across different image qualities. In terms of the Sentiment Analysis Module, it correctly analyzed the processed text and categorized feedback into positive, negative, or neutral sentiments. This confirmed that the system was able to interpret client feedback automatically and provide meaningful insights for administrative evaluation.

Finally, the Report Generation Module successfully produced complete and accurate reports based on extracted and analyzed data. The generated outputs matched the expected structure and analytics, demonstrating that the system can provide reliable summaries and decision-support materials for LSPU-SPCC MIS. The successful validation of the Feedback Extraction and Sentiment Analysis modules aligns with the findings of Smith et al. (2022), who emphasized that integrating Optical Character Recognition (OCR) with sentiment analysis significantly enhances the processing speed and accuracy of educational feedback systems. Furthermore, the reliable performance of the report generation module supports the assertions by Bhimavarapu (2025) regarding the critical role of automated data processing in generating rapid, actionable insights for institutional administrators.

Generally, all modules passed their respective test cases, indicating that the system's core functions, such as image uploading, data extraction, sentiment analysis, and report generation, operated smoothly and in accordance with the system requirements.

On the other side, Table 9 reveals the results of the end-to-end testing conducted on the automated image and data processing system for client feedback analysis. This testing evaluated how well the system performs when all modules work together, from image upload to report generation. Each test case includes the complete workflow, expected outcomes, and overall system behavior during actual usage scenarios.

Table 9. System Testing Results

Test Case	Test Steps	Expected Results	Status
End-to-End Image Upload Validation	1. Upload an image containing the client feedback. 2. Submit image for processing.	The image is successfully uploaded and stored in the system.	Passed
End-to-End Feedback Extraction	1. Upload an image 2. The system extracts text from the image.	Extracted text matches the content in the uploaded image.	Passed
End-to-End Sentiment Analysis	1. Process extracted feedback. 2. Analyze sentiment classification (positive, negative, neutral).	Feedback is correctly classified based on sentiment analysis.	Passed
End-to-End Report Generation	1. Access the reports section. 2. Generate a feedback summary report.	The report is generated with an accurate analysis.	Passed

The end-to-end image upload validation confirmed that the system can successfully accept and store survey images for processing. When users uploaded feedback forms, the system consistently received the files without errors, ensuring a smooth start to the entire automated workflow. Moreover, the end-to-end feedback extraction test validated the accuracy of the OCR process. After uploading an image, the system extracted text that matched the original content of the form. This ensures that the extracted data is reliable and suitable for further analysis.

When it comes to the end-to-end sentiment analysis, the test verified that the system can correctly interpret and classify client feedback. Using the extracted text, the system accurately assigned sentiment labels positive, negative, or neutral, demonstrating that the analysis module functions effectively within the complete workflow. Lastly, the end-to-end report generation test confirmed that the system can produce a complete feedback summary report based on the extracted and analyzed data. The generated report displayed accurate information and analyses, ensuring that administrators receive dependable output for decision-making.

This seamless end-to-end processing capability, from initial image upload to final report generation, corroborated the framework proposed by Iqbal et al. (2023), which highlighted that fully integrated automated feedback systems are crucial for maintaining consistent data flow and improving overall administrative efficiency. The system's ability to maintain data integrity across all connected modules accentuates the practical viability of deploying mobile-based workflow automation within academic institutions. Overall, each end-to-end test case achieved its expected outcome, indicating that the system performs reliably as an integrated solution from image input to final report output.

Table 10. Accuracy Testing Results

Test Case	Test Steps	Expected Results	Status
Verify extraction of numerical ratings	Use the mobile app to scan survey forms containing numerical ratings.	App accurately reads and extracts all numerical values.	Passed
Verify extraction of checkbox responses	Scan forms with different checkbox selections using the mobile camera.	All checked boxes should be correctly detected and recorded.	Passed
Verify extraction of categorical responses	Scan forms with varying category selections (e.g., Excellent, Good, Poor).	The app accurately identifies and extracts the correct category.	Passed
Ensure personal information is ignored	Scan forms containing optional name or contact details.	The app automatically ignores personal information fields.	Passed

Table 10 shows the results of the specialized data extraction testing performed on the automated image and data processing system for client feedback analysis. This set of tests focused specifically on how accurately the system reads and interprets different types of information found in client feedback forms. Each test case examined a unique data type to ensure that the OCR and extraction modules function consistently across various input formats. The numerical ratings extraction test verified that the mobile application can accurately detect and extract numeric values from survey forms. Ratings such as 1–5 were consistently captured without errors, confirming the system's capability to handle quantitative data essential for performance evaluation.

Also, the checkbox response extraction test ensured that the system could correctly detect all selected checkboxes on the form. During scanning, all checked fields were accurately recognized and recorded, demonstrating the reliability of the system's pattern recognition for non-text data. In terms of the categorical response extraction test, it validated the system's ability to interpret category-based responses, such as "Excellent," "Good," or "Poor." Regardless of form variations, the system consistently extracted the correct category, ensuring accurate classification of client feedback. Lastly, the personal information exclusion test assessed whether the system could filter out optional personal identifiers such as names or contact details. The system successfully ignored these fields during processing, supporting data privacy and ensuring that only relevant feedback data is captured.

Hence, the system's high accuracy in extracting diverse data types, such as checkboxes and categorical responses from varying form layouts, confirmed the principles outlined by Ha and Horák (2022) as well as Abdallah et al. (2024). Their studies established that advanced layout features and structural text analysis are essential for reliably extracting structured information, even from complex or imperfectly scanned documents. By successfully ignoring optional personal identifiers, the system also adheres to standard data privacy protocols required in automated feedback processing.

Therefore, all test cases achieved their expected results and were marked as passed, demonstrating the system's strong capability in accurately reading and processing diverse data types present in client feedback forms.

Table 11. Performance Testing Results

Test Case	Test Steps	Expected Results	Status
Measure of Scanning and Extraction Time for a Single Form	Scan one survey form using the mobile camera.	The app processes and extracts data within a few seconds.	Passed
Batch Processing Duration (Multiple Scans)	Scan 10–20 survey forms consecutively.	The app maintains consistent speed with no performance drop.	Passed
App Responsiveness Under Continuous Use	Use the app to scan forms repeatedly for 10+ minutes.	App remains responsive; no freezing or unexpected closing.	Passed
Export Time to Excel or Summary Output	Export extracted data to Excel or to an in-app summary.	The file is generated quickly and accurately.	Passed

Table 11 accentuates the results of the performance testing conducted on the automated image and data processing system for client feedback analysis. This testing focused on evaluating the system's speed, stability, and overall responsiveness when handling both single and multiple survey forms. The goal was to ensure that the system performs efficiently under normal and extended usage conditions. The single-form scanning and extraction test measured how quickly the system could process one survey form. Results showed that the application was able to scan and extract data within a few seconds, demonstrating fast processing suitable for real-time feedback handling.

Additionally, the batch processing duration test assessed the system's ability to handle multiple consecutive scans. When scanning between 10 and 20 survey forms, the application maintained consistent processing speed without slowdowns, confirming that the system is optimized for bulk operations commonly required during peak enrollment or feedback collection periods. Likewise, the app's responsiveness under a continuous use test evaluated the system's stability over prolonged use. After scanning forms continuously for more than 10 minutes, the application remained responsive, with no freezing, lagging, or unexpected shutdowns. This indicated strong performance reliability even under sustained workloads.

Lastly, the export time to the Excel test verified how quickly the system could generate outputs once data extraction was complete. The application successfully produced Excel files and summary outputs quickly and accurately, ensuring seamless integration with reporting processes and administrative requirements.

The efficient processing times and stability during batch scanning prove the exponential efficiency gains achieved when digitizing paper-based customer forms using OCR (Marshanda et al., 2024). Additionally, the system's robust performance during continuous mobile scanning validated the practical viability, sustained speed, and reliability of mobile phone scanner technologies in active operational environments (Permana et al., 2020). Overall, the performance tests were marked as passed, confirming that the system delivers fast, stable, and dependable performance across different usage scenarios.

Table 12. Error Handling Testing Results

Test Case	Test Steps	Expected Results	Status
Scan blurry or shaky images	Take a blurry photo of the survey form using the mobile camera.	The app notifies the user to retake the photo due to low clarity.	Passed
Scan incomplete survey forms	Scan forms with missing answers or blank sections.	The app alerts the user to incomplete data or highlights missing fields.	Passed
Scan a wrong or outdated form template	Attempt to scan forms that do not match the required layout.	The app displays an error indicating "Invalid Form Template."	Passed
Scan forms with unreadable handwriting	Scan forms with unclear or messy writing.	The app identifies unreadable areas or warns the user.	Passed

Table 12 reflects the results of the error handling testing conducted on the automated image and data processing system for client feedback analysis. This testing was designed to evaluate how effectively the system detects, manages, and responds to various user errors and problematic input conditions. These scenarios simulate real-world issues that may occur during scanning and ensure the system remains reliable even when encountering incorrect or low-quality data. The blurry or shaky image test verified how the system responds to unclear survey photos. When testers scanned blurry images, the application correctly notified users to retake the photo due to insufficient clarity. This prevents inaccurate extraction and ensures only readable forms proceed to processing.

Similarly, the incomplete survey form test examined the system's ability to detect missing data. When forms with blank sections or unanswered items were scanned, the system successfully alerted users about the incomplete fields, prompting verification before continuing. This improves data accuracy and prevents gaps in exported reports. Likewise, the wrong or outdated template test assessed the system's capability to identify incorrect survey formats. When users attempted to scan templates that did not match the required layout, the application displayed an "Invalid Form Template" warning. This protects the system from processing unrelated or incompatible documents.

Finally, the unreadable handwriting test ensured that the system could handle unclear handwritten responses. In cases where handwriting was messy or difficult for the OCR to recognize, the system flagged the problematic areas and informed the user, ensuring corrections could be made before exporting. The system's proactive error-handling mechanisms, specifically its ability to reject blurry images, determine incomplete forms, and identify invalid templates, are critical for maintaining overall data integrity. As established in broader literature on automated data extraction, robust input validation at the scanning phase is strictly necessary to prevent the processing of inaccurate or unreadable data (Valencia et al., 2023; Myrta, 2025; Lalit et al., 2018). This ensured that the final datasets utilized by decision-makers remain highly reliable and free from the input errors that traditionally plague manual encoding processes.

Overall, the system consistently recognized and handled all tested error scenarios, demonstrating strong robustness and reliability. Each test case was marked as passed or failed depending on the input, confirming the system's ability to guide users and maintain data accuracy even under challenging conditions.

Quantitative System Evaluation

The system's performance was measured using exact quantitative metrics to replace purely pass/fail testing formats. During the evaluation of 150 test forms, the system demonstrated significant improvements in speed and accuracy.

Table 13. Quantitative Performance and Accuracy Metrics

Metric / Test Parameter	Actual Measurement	Status / Result
OCR Character Accuracy Rate	96.4%	Highly Accurate
Field-Level Extraction Accuracy	94.2%	Highly Accurate
Checkbox Detection Accuracy	98.1%	Excellent
Sentiment Classification Precision	0.89	Reliable
Sentiment Classification F1-Score	0.91	Reliable
Average Processing Time (per form)	2.5 seconds (SD: ±0.4s)	Efficient
Failed Scans / Unreadable Forms	4 out of 150 forms	2.6% Error Rate
Manual Encoding Time (Baseline)	45.0 seconds (per form)	-

The comparative data shown in Table 13 reveal that the automated system reduces processing time by approximately 94.4% (from 45.0 seconds manually to 2.5 seconds automated) while maintaining a high OCR character accuracy rate of 96.4% and an excellent checkbox detection accuracy of 98.1%. This dramatic reduction in processing time, alongside high precision scores, provides empirical evidence, as corroborated by Marshanda et al. (2024), Shin (2012), and Biggam (2010), who argued that automating paper-based feedback forms yields exponential efficiency gains for service industries and academic institutions alike.

On the other hand, Table 14 shows that the ISO/IEC 25010 evaluation yielded an overall weighted mean of 4.39, interpreted as "Very Good". The highest ratings in performance efficiency (4.50) and functional suitability (4.43) confirmed that the system not only meets the operational requirements of the LSPU-SPCC MIS office but also sets a strong standard for implementing automated, mobile-based feedback analysis systems in academic settings. This can be due to the system being a reliable and effective solution for streamlining feedback analysis and can serve as a model for similar digital initiatives in higher education institutions (Kapoor, 2025; Uday & Raman, 2025).

Table 14. ISO/IEC 25010 Complete Evaluation Mean Scores

Criteria	Mean Score	Interpretation
Functional Suitability	4.43	Very Good
Reliability	4.41	Very Good
Usability	4.35	Very Good
Performance Efficiency	4.50	Very Good
Maintainability	4.28	Very Good
Portability	4.38	Very Good
Overall Weighted Mean	**4.39**	**Very Good**

Conclusion and Future Works

This study successfully designed, developed, and evaluated an automated image and data processing system for client feedback analysis at Laguna State Polytechnic University – San Pablo City Campus (LSPU–SPCC). The Automated Image and Data Processing System served as a highly promising prototype that has been successfully validated under controlled pilot testing conditions at LSPU-SPCC MIS. By integrating mobile OCR and automated Excel reporting, the system met all its primary objectives. Comparative workflow analysis proved that the system significantly reduced manual encoding by lowering the average processing time from 45.0 seconds to 2.5 seconds per form, minimizing human error rates, and generating instant quantitative outputs for decision-makers.

For future work, it is recommended that, before the full institutional-level deployment, large-scale comparative evaluations be made. Furthermore, to address the limitations of generic machine learning upgrades and the challenges of reading poor handwritten responses, future iterations could explore specialized "Handwriting-Text-Recognition" architectures, such as transformer-based models, to maximize text classification accuracy.

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Artificial Intelligence Declaration Statement

The authors declare that artificial intelligence (AI) and large language models (LLMs) were used solely for minor copyediting, grammar correction, and structural formatting of the manuscript. All core research, system development, data collection, statistical analysis, and original conclusions are the exclusive intellectual property of the human authors.

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Conflict of Interest

The authors declared that there are no conflicts of interest regarding the publication of this paper.