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Design of a Cloud-Based Reporting System for Real-Time Project Monitoring at SS Partner Portal

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***Abstract*— The operational management of infrastructure and visual marketing projects in the field is often hindered by manual data collection, which is prone to location inconsistencies, loss of physical documents, and inefficient report generation. This study aims to address these issues through the design and implementation of the PT. SS Partner Portal, an integrated cloud-based reporting system. The system was developed using an applied software engineering approach with a three-tier serverless architecture within the Google Workspace ecosystem. The frontend was built using HTML and CSS, the backend logic is driven by Google Apps Script (GAS), and data storage utilizes Google Sheets and Google Drive. The results indicate that the system successfully automates the entire reporting workflow, including geotagging, autocomplete search, Base64 image conversion, and dynamic archive routing. Furthermore, the system automatically generates PDF reports via event-driven triggers and provides a real-time project progress monitoring dashboard. This implementation effectively reduces administrative processing time, minimizes human error, and secures field data integrity without burdening the company with server rental costs (zero-cost architecture).**

Keywords— Cloud Computing, Google Apps Script, Reporting Automation, Serverless Architecture, Project Management

Intisari— **Pengelolaan operasional proyek infrastruktur dan pemasaran visual di lapangan sering kali terhambat oleh pengumpulan data secara manual, yang rentan terhadap ketidakkonsistenan lokasi, hilangnya dokumen fisik, serta pembuatan laporan yang tidak efisien. Penelitian ini bertujuan untuk mengatasi masalah-masalah tersebut melalui perancangan dan implementasi PT. SS Partner Portal, sebuah sistem pelaporan terintegrasi berbasis cloud. Sistem ini dikembangkan menggunakan pendekatan rekayasa perangkat lunak terapan dengan arsitektur tiga lapis tanpa server (serverless) dalam ekosistem Google Workspace. Bagian frontend dibangun menggunakan HTML dan CSS, logika backend digerakkan oleh Google Apps Script (GAS), dan penyimpanan data memanfaatkan Google Sheets serta Google Drive. Hasil penelitian menunjukkan bahwa sistem ini berhasil mengotomatiskan seluruh alur kerja pelaporan, termasuk penandaan geolokasi (geotagging), pencarian otomatis (autocomplete), konversi gambar ke format Base64, dan perutean arsip dinamis. Selain itu, sistem ini secara otomatis menghasilkan laporan PDF melalui pemicu berbasis peristiwa dan menyediakan dasbor pemantauan kemajuan proyek secara real-time. Implementasi ini secara efektif mengurangi waktu pemrosesan administratif, meminimalkan kesalahan manusia, dan menjamin integritas data lapangan tanpa membebani perusahaan dengan biaya sewa server (arsitektur tanpa biaya).**

Kata kunci— Komputasi Awan, Google Apps Script, Otomatisasi Pelaporan, Arsitektur Tanpa Server, Manajemen Proyek.

I. INTRODUCTION

The management of large-scale infrastructure projects and visual marketing campaigns spread across various geographical areas requires a responsive, accurate and centralised flow of information. In practice, the day-to-day operational management of Shop Signage (PNT), Warehouse Signage (PNG) and mural painting by field staff from the implementing partner (PT XYZ) often encounters bottlenecks. The main limitations of this conventional data collection method give rise to the risk of inconsistencies in location reporting, the loss of physical supporting documents (such as permits and Local Government Agency Certificates/SKPDs), and significant time constraints (inefficiencies) in compiling final reports in PDF format. To address these challenges, digital transformation through the utilisation of a cloud computing ecosystem has become a crucial priority for the realisation of the Partner Portal.

The use of cloud-based information systems has proven capable of revolutionising data management by improving efficiency, transparency and the accuracy of information in real time, without the need for costly physical server infrastructure [1]. In particular, the use of the Google Workspace ecosystem has proven effective not only as a work tool, but also as a means of enhancing the digital skills of professionals across various sectors [2]. The flexibility of this ecosystem is particularly relevant for the civil service, where the integration of its services using Google Apps Script (GAS) has successfully made it much easier to manage regional administrative data archives in real time [3].

When it comes to lightweight relational database management, Google Sheets has been widely recognised for its reliability. Using Google Sheets as a database has proven to speed up structured data recording and significantly reduce the risk of operational data loss [4]. This is supported by another study which shows that Google Sheets is an efficient solution, is

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perceived as easy to use, and is highly useful for automating report generation [5]; [6].

Furthermore, the capabilities of Google Apps Script have proven to be highly effective when combined with scripting logic for the automation of document creation. The implementation of automation in data flow management can reduce the time taken to produce official documents and distribute data between departments by up to 70 per cent [7]. Automated data flow (event-driven architecture) also streamlines the completion of project management tasks and drastically reduces the incidence of human error [8]. This concept of real-time monitoring is crucial in construction projects, where tracking progress enables efficiency to be calculated with precision [9], and is highly reliable for managing commercial stock [10].

Recent studies have consistently highlighted the effectiveness of Google Apps Script as a robust middleware in cost-efficient serverless architectures. A cloud ecosystem driven by GAS has proven capable of automating real-time and scalable device log processing [11] . Moreover, its integration with Google Sheets has been widely adopted in modern web-based inventory systems, successfully functioning as a low-latency alternative to traditional relational databases [12] . A similar approach was validated in public administration systems, where GAS automation significantly reduced service processing time and document bureaucracy [13] . Furthermore, the dynamic integration capabilities of GAS have been tested for managing centralized equipment borrowing systems, yielding conflict-free automated data logging [14] . The versatility of this ecosystem is even sufficient to handle asynchronous data operations for public transportation announcement facilities [15] .

However, no matter how sophisticated a system may be, the success of its implementation depends heavily on the quality of interaction with its users. Previous research has shown that interface quality and perceived ease of use have a strong positive correlation with user satisfaction and their intention to continue using the information system [16].

Although the use of Google Apps Script and Google Sheets has been widely explored, a technical integration that comprehensively combines automatic geolocation validation (GPS), interactive location autocomplete with a modern interface (CSS), Base64 image file conversion, dynamic routing of Google Drive's hierarchical folder structure, and one-click PDF report generation is still rarely examined within a single integrated architecture.

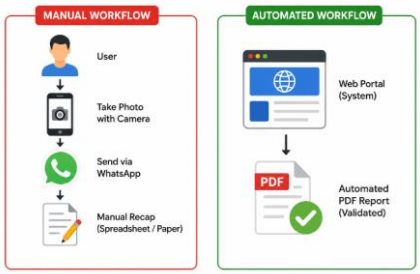


Fig. 1. A Comparison of Conventional Operational Reporting Workflows and Cloud-Based Integrated Workflows on the Partner Portal.

On the Fig. 1. We can see the realisation of the Partner Portal. Building on the identification of these technical gaps, this study documents the design, implementation and analysis of the use of the Partner Portal. The primary objective of this implementation is to provide adaptive and user-friendly automation of data management processes, from the operational level in the field right through to direct visualisation via a monitoring dashboard for management.

II. METHODS

This research employs an applied software engineering approach that focuses on the design, implementation and testing of cloud-based information systems. The system has been specifically designed to facilitate the three main operational reporting tools used by PT XYZ as the implementing vendor, namely: Shop Signboards (PNT), Warehouse Signboards (PNG), and mural painting installations. The choice of the cloud computing approach was based on the urgent need to reduce the inefficiencies of manual reporting and to create transparency of information amongst stakeholders.

A. System Architecture

The Partner Portal utilises a serverless architecture that is fully integrated within the Google Workspace ecosystem. This approach is in line with the trend towards adopting cloud technology, which reduces hardware and software infrastructure costs (zero-cost architecture) whilst maintaining a high level of reliability [1]. This system is built on three main layers:

1. Client-Side (User Interface)

The front-end layer was developed using pure HTML5 combined with interface utilities from the CSS framework. CSS was chosen to ensure that the user interface (reporting forms, SKPD/licence uploads and the dashboard) is responsive and optimised for mobile devices (mobile-friendly). Component interactivity is fully controlled using Vanilla JavaScript.

2. Middleware/Server-Side (Processing Logic)

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This middleware layer is powered by Google Apps Script (GAS), which responds to client requests asynchronously via the `google.script.run` API. The use of GAS as a backend has proven effective in streamlining administrative processes and managing large-scale data archives [3].

3. Storage-Side (Databases and Repositories)

Rather than using a conventional SQL database server, this system adapts the functionality of Google Sheets to serve as a lightweight relational database management system. This decision is based on empirical evidence that the use of Google Sheets has successfully accelerated the process of structured data recording whilst minimising the risk of operational data loss [4]. At the same time, Google Drive is used as the primary cloud object storage for storing image and PDF files.

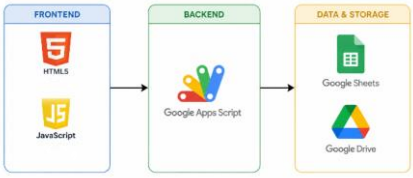


Fig. 2. Three-Tier Architecture of the SS Partner Portal Based on Google Workspace.

So, as has been explained before the system built is designed on three main layers, as illustrated in Fig. 2.

B. Data Workflow

The system is designed with a rigorous automated workflow to minimise the incidence of human error in data recording in the field. The adoption of this digital data flow mechanism is in line with the principle of minimising manual recording errors in modern commercial operations [10]. The following outlines the technical mechanism of the system:

1. Smart Search (Autocomplete) and Data Validation

The system fetches master data from the backend (GAS) and loads it into an array on the client side (browser). A local search algorithm matches the string typed by the user in real time to generate a list of suggestions (drop-down suggestions) containing valid information on shop names, IDs and project categories.

2. Geolocation Validation (Geotagging) and Image Object Processing (Base64 Encoding)

To ensure the integrity of the report, access to the form requires the execution of the HTML5 Geolocation API, which automatically records precise coordinates. Furthermore, to address photo upload failures caused by unstable signals in the field, JavaScript uses FileReader to convert images (before, after and additional photos) into Base64 text strings. These strings are then transmitted to GAS to be decoded back into physical files on Google Drive.

3. Creating Dynamic Directories (Dynamic Folder Routing)

The system implements programmed folder routing. The detection algorithm will automatically create new sub-directories (folders) if the name of the reporter's "Province" or "City" is not already present in the Google Drive root repository. This automation of structured data flow replicates the reliability of event-driven architecture, which has successfully reduced administrative redundancy in the project [8].

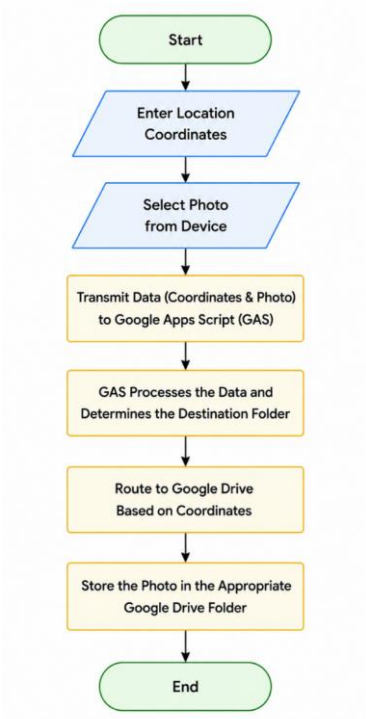


Fig. 3. Flowchart of the Mechanism for Synchronising Field Reporting Data from Clients to Cloud Storage.

The following outlines the technical mechanism of the system that is visualized in the Fig. 3. above.

III. RESULT AND DISCUSSION

The implementation of the SS Partner Portal has successfully integrated field reporting workflows and centralised data management into a single serverless ecosystem. System functionality testing has demonstrated that all operational modules at PT XYZ are functioning optimally without the need to rent external physical servers.

To validate this, functionality testing was performed on core operational modules using a black-box testing approach. The test scenarios ensured that location tracking, data acquisition, image processing, and automation triggers were executed in

accordance with the established requirements, as detailed in Table I. below

Table I.

Module	Test Scenario	Expected Output	Actual Result	Status
GPS Geotagging	Access the reporting form via a mobile browser in the field.	HTML5 Geolocation API successfully captures and records latitude and longitude coordinates.	Coordinates were recorded successfully.	Valid
Store Autocomplete	Input partial characters of a registered store name.	The system retrieves matching store records and dynamically displays suggestions in a drop-down list.	Matching suggestions were displayed as expected.	Valid
Base64 Image Conversion	Upload high-resolution photos over an unstable cellular network.	The FileReader API converts the image into a Base64 string, which is transmitted to Google Apps Script (GAS) and decoded into an image file stored in Google Drive.	Image uploads took longer under unstable network conditions, but the process completed successfully.	Valid
PDF Generation Trigger	The administrator selects the verification checkbox in Google Sheets.	The GAS trigger detects the relevant edit event and invokes the printPDF() function to generate the PDF document.	The PDF document was generated and stored in the intended location.	Valid
Automated ZIP Archiving	Request a bulk archive of documents and images associated with a specific province.	The script compiles the associated PDF documents and images into a single ZIP archive and provides a download link.	The ZIP archive was generated successfully. Processing time varied depending on the file size and Google Drive operations.	Valid

As shown in Table I, all five core operational modules completed their respective black-box testing scenarios with the expected functional outcomes. However, unstable network conditions increased image upload times, while ZIP archive generation time varied depending on file size and Google Drive operations. These findings indicate that the system's core functions operated as expected under the tested conditions, supporting its use for field data collection and automated document generation. Nevertheless, further testing with repeated trials and quantitative performance measurements is required to assess the system's reliability and performance comprehensively.

A. Verification Automation and Document Generation

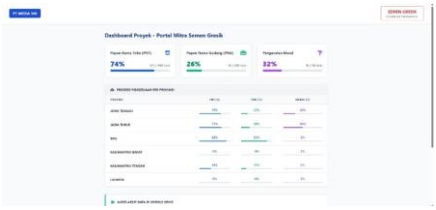


Fig. 4. The verification of Automation and Document generation

On The Fig. 4. Above we can see the visualization of the document verification and generation. One of the most crucial outcomes of the backend design for this system is its capability for event-driven automation. The process of report verification by administrators no longer requires the manual compilation of photographs or the manual layout of documents.

The system utilises a trigger function that reacts to changes to a checkbox in the Google Sheets database (represented in the verification status column). When an administrator ticks the validation box, the script asynchronously reads the project cluster variables and initiates the printPDF() function. This algorithm instantly populates the report template parameters, inserts high-resolution images (of the before, after and additional conditions) into the spreadsheet cells, exports them as a print-ready PDF file, and places the file into the archive directory in a hierarchical structure.

Based on system execution logs during deployment, the event-driven PDF generation (printPDF()) completes in an average of 4.2 seconds per report. Furthermore, the Auto-Zip extraction algorithm for batch archiving processes up to 50 documents in under 15 seconds. This actual execution time data demonstrates

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a reduction in administrative processing time exceeding 90% compared to manual compilation, which previously required up to 45 minutes per project. This empirical outcome substantively surpasses the 70% efficiency benchmark cited in previous literature [7]. After that, it will places the file into the archive directory in a hierarchical structure as can be seen on Fig. 5. below

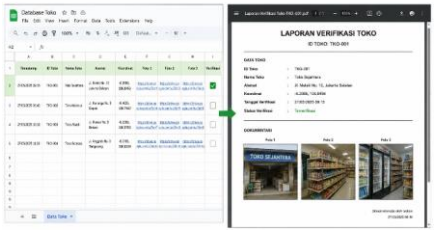


Fig. 5. The data verification mechanism (checkbox trigger) in the database and the final output of the automated report in PDF format.

B. Performance-Based Project Monitoring Dashboard

The results of the transaction data processing are visualised interactively via the PT XYZ Project Dashboard interface. This dashboard enables the management teams at SS and PT XYZ to monitor the progress of work on shop signage (PNT), warehouse signage (PNG) and mural painting in real time.

This interface dynamically calculates the percentage of completion for nationwide installation targets and breaks this down into a performance table by province. The introduction of this monitoring interface embodies the concept of project management based on transparent performance indicators, in line with the principles of digital construction progress monitoring, which has proven successful in accurately determining the actual level of project completion [9]. In addition, the dashboard features an asynchronous search function (Custom Autocomplete Search) that allows users to track report history without having to reload the page.

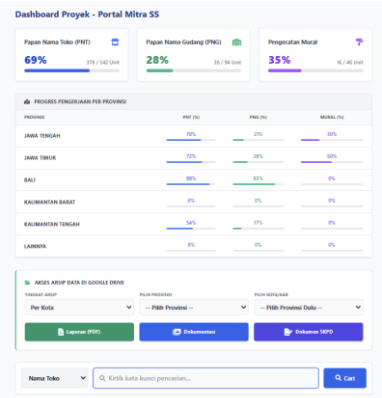


Fig. 6. An interactive dashboard interface for monitoring the progress of PT XYZ's national projects, built using HTML and CSS.

The results of the transaction data processing are visualised interactively via the PT XYZ Project Dashboard interface that can be seen on Fig. 5. above.

C. Centralised Archive Management and Bulk Extraction (Auto-Zip)

The system efficiently eliminates the risk of losing crucial physical documents (such as permits and SKPDs) through automatically generated Google Drive sub-directories. To support final reporting to clients, the system's backend is equipped with an Auto-Zip algorithm. Administrators can extract hundreds of photo archives and PDF documents from a particular province or city with a single click. The system will compile and compress the documents into a .zip format, and provide a download link. This extraction feature is crucial for optimising the management of a neat and centralised digital archive [3].

D. Discussion

In operational terms, this system has tangible implications:

1. Time Efficiency

Automated document generation cuts down on repetitive manual administrative tasks, speeding up the completion of administrative work in line with the volume of work in the field [7].

2. Zero-Cost Architecture

Leveraging the Google Workspace serverless ecosystem has proven capable of managing data and images without burdening businesses with costly monthly infrastructure maintenance fees [1].

3. Data Integrity

Geolocation tracking must ensure the integrity of evidence of work carried out in the field, transforming this portal into a reliable Decision Support System (DSS) tool for SS's management.

IV. CONCLUSIONS

The design and implementation of the SS Partner Portal using the Google Workspace serverless ecosystem has successfully addressed issues of inefficiency in project administration and operational management at PT XYZ. The use of Google Apps Script (GAS) as the central backend logic has proven highly reliable in automating the entire field reporting cycle, from the capture of precise coordinate points (geotagging) and location search validation (autocomplete) to the conversion of digital images from Base64 format into a Google Drive repository structured hierarchically by province and city.

This research confirms that high-performance digital transformation does not necessarily require costly server infrastructure. By combining a responsive HTML interface with CSS, Google Sheets as a dynamic relational database, and GAS trigger scripts, this system has successfully delivered intelligent functionality in the form of auto-generated PDF reporting documents, bulk file compression (Auto-Zip), and real-time progress dashboard visualisation. The practical benefits of this system's development lie in its ability to reduce redundant administrative workloads and minimise human error, whilst equipping management with transparent, reliable and efficient tools for monitoring operations across different regions.

As a suggestion for future development, the functionality of this portal could be enhanced by integrating an artificial intelligence (AI/computer vision) module to automatically analyse and validate the composition of images of shop sign installations or murals before the data is permanently recorded in the database.

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