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SYNERGIZING COULD AND ON-PROMISES: A KNOWLEDGE MANAGEMENT TOOL FOR LABORATORIO DI STORIA ORALE

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Abstract

This thesis delves into an investigation centered on the deployment of an online knowledge management tool within the *Laboratorio di Storia Orale* (Oral History Laboratory) at the University of Padova. The primary aim of this research is to conceptualize and implement a proficient tool dedicated to archiving and facilitating public access to diverse media formats, including audio and video. In pursuit of this objective, the study capitalizes on the integration of artificial intelligence (AI) through a hybrid deployment approach.

By harnessing the capabilities of hybrid deployment, which combines on-premises and cloud-based solutions, the research endeavors to optimize the tool's functionality and efficiency. The utilization of AI-driven technologies further enhances the tool's capabilities, fostering improved archiving, retrieval, and accessibility of multimedia content. The findings of this research shed light on the advantages and potential afforded by a hybrid development strategy in the realm of knowledge management tools, particularly when coupled with AI augmentation.

In addition to providing insights into the practical applications of hybrid deployment, this thesis contributes valuable knowledge to the existing academic discourse surrounding knowledge management tools. The exploration of the implementation within the context of the *Laboratorio di Storia Orale* not only addresses the specific needs of this oral history repository but also offers broader implications for similar initiatives seeking efficient and advanced knowledge management solutions. Keywords encompassing the research scope include knowledge management tools, AWS (Amazon Web Services), and hybrid deployment.

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I would like to express my sincere gratitude to the individuals whose guidance, support, and encouragement have been instrumental in the successful completion of my Master's thesis, "Synergizing Cloud and On-Premises: A Knowledge Management Tool for *Laboratorio di Storia Orale*."

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I am also deeply thankful to Prof. Elizabetta Novello, my co-supervisor, whose leadership as the head of *Laboratorio di Storia Orale* provided invaluable insights into the unique challenges and requirements of this project. Her guidance was pivotal in navigating the intricacies of implementing a knowledge management tool within the context of oral history archiving.

I extend my gratitude to all the professors at the Department of Information Engineering, with whom I had the privilege of taking courses during my academic journey. Their teachings and expertise have enriched my understanding and contributed significantly to my intellectual growth.

Lastly, I want to express my heartfelt thanks to my parents and friends, whose unwavering support and encouragement sustained me throughout my studies. Their emotional support provided the necessary foundation for navigating the challenges of academia.

This thesis represents not only an individual accomplishment but also a collective effort, and I am grateful for the collaborative spirit that has defined this academic journey.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Background

Oral history has grown in popularity as a crucial tool for preserving and understanding the experiences of individuals and communities via personal narratives. With a focus on oral history, *Laboratorio di Storia Orale* plays an important role in documenting and safeguarding narratives that would otherwise be lost to time. As technology advances, there is an increasing need for innovative tools that can facilitate the management and accessibility of oral history archives.

Traditional methods of archiving, such as physical recordings and transcriptions, are often limited in scalability and accessibility; however, the advent of digital technologies provides opportunities to overcome these limitations and improve the preservation and dissemination of oral histories. This research project aims to address these challenges by developing a knowledge management tool tailored to the specific needs of *Laboratorio di Storia Orale*.

1.1.1 Significance of the Project

The *Laboratorio di Storia Orale*'s collection of interviews, projects, and multimedia materials has enormous cultural and historical value; however, the efficient organization, retrieval, and presentation of this content presents challenges. This project seeks to bridge the gap between the rich oral history resources and contemporary digital solutions by providing an integrated platform for the storage, management, and public dissemination of audio, video, and project materials.

1.1.2 Motivation

The motivation for this project stems from the recognition of the importance of preserving oral history in the digital age. By leveraging cloud technologies such as AWS S3 and Lambda, we hope to improve the accessibility and reliability of audio content. The development of an intuitive admin panel will also allow *Laboratorio di Storia Orale* to seamlessly maintain and expand its digital archive.

1.1.3 Objectives

The key goals of this research project are to build and implement a knowledge management solution that:

- Streamlines the archival process for *Laboratorio di Storia Orale*.
- Integrates AWS cloud services for audio storage and retrieval.
- Provides a user-friendly admin panel for easy content management.
- Enhances the user interface for a seamless and engaging experience.
- Contributes to the broader field of digital preservation of oral history.

1.1.4 Scope and Limitations

While this project aims to provide a comprehensive solution for oral history management, it is important to recognize its scope and limitations. The tool developed will cater specifically to the needs of *Laboratorio di Storia Orale* and may require further customization for broader applications. Furthermore, privacy, copyright, and ethical implications will be addressed throughout the development and implementation phases. In the following chapters, we will delve into the literature surrounding knowledge management tools, the methods used in the tool's creation, and the specific features and functionalities that comprise *Laboratorio di Storia Orale*'s knowledge management platform.

1.1.4.1 Requirements and Scope

The Knowledge Management Tool is intended for public use and specifically caters to the needs of history department students. The tool supports a diverse range of media types, including audio, video, images, and text, allowing for the

comprehensive archiving of data related to each project. The user-friendly admin panel facilitates efficient management of the tool's content, aligning with the tool's design.

1.1.4.2 Financial Limitations

Due to financial constraints, we chose the university's on-premises hosting. This decision was made to minimize costs for *Laboratorio di Storia Orale*, ensuring that no additional financial burden is incurred. Additionally, aligning with the University of Padova's financial planning considerations made the hosting arrangement more feasible.

Chapter 2

Deployments Models and Cloud Benfits

2.1 Overview

Cloud computing has indeed revolutionized the way organizations deploy and manage their IT infrastructure. The emergence of different cloud deployment models, such as public, private, community, and hybrid clouds, has provided organizations with a range of options to suit their specific needs [19]. These deployment models offer varying levels of control, security, and customization, allowing organizations to tailor their cloud infrastructure to their unique requirements [27]. For instance, the public cloud model, as offered by AWS, provides services to the general public, enabling organizations to access scalable and on-demand resources [29].

2.1.1 AWS benefits for big organizations

Furthermore, the key benefits of cloud providers like AWS, including flexibility, pay-as-you-go models, and scalability, have significantly impacted the way organizations manage their IT resources. AWS's pay-as-you-go model allows organizations to pay only for the resources they consume, providing cost-efficiency and flexibility in budgeting. Additionally, the scalability of cloud services enables organizations to dynamically adjust their resource allocation based on demand, ensuring optimal performance and cost-effectiveness.

Moreover, the ability for big organizations to manage all their projects and departments under a single organizational AWS account offers centralized control

and streamlined management. This centralized approach allows for efficient resource allocation, cost tracking, and the potential for volume discounts based on usage.

In conclusion, the evolution of cloud deployment models and the emergence of cloud providers like AWS have transformed the IT landscape, offering organizations unprecedented flexibility, scalability, and cost-efficiency in managing their IT infrastructure.

2.1.2 Organizational accounting for AWS

To effectively utilize AWS under one organizational account, big organizations can implement best practices by leveraging the pay-as-you-go model for AWS services. This model allows organizations to pay only for the resources they consume, providing flexibility and cost-efficiency (Castro et al., 2019)[6]. To manage accounting and budgeting, organizations can adopt exceptional decision-making practices during crises, such as the COVID-19 pandemic, by using accounting practices to make informed decisions at the organizational level (Leoni et al., 2021)[17]. Additionally, the strategic use of Information Systems (IS) can support decision-makers in making successful decisions, which is crucial for effective budgeting and accounting within large organizations (Aversa et al., 2018)[2]. Furthermore, the rise of serverless computing and its pay-as-you-go model has paved the way for the implementation of budget-restricted management systems, which can be beneficial for organizations aiming to optimize their AWS usage within budget constraints (Shafiei et al., 2022)[24].

In terms of organizational change and alignment, it is essential for organizations to consider the compatibility, complexity, and efficiency of Enterprise Resource Planning (ERP) systems, as well as the organizational and environmental contexts, to ensure effective utilization of AWS services under one account (Hassan Mouakket, 2016)[10]. Moreover, the adoption of cloud-based solutions, such as AWS, with the pay-as-you-go service model, has become a common practice for businesses, indicating its relevance and applicability for large organizations (Gul et al., 2020)[9]. Additionally, the sensitivity analysis of cloud data centers and disaster recovery mechanisms can provide insights into optimizing the availability of cloud services, which is crucial for budgeting and accounting purposes within big organizations utilizing AWS (Silva et al., 2018)[25].

Overall, the best practices for big organizations to use AWS under one organizational account involve leveraging the pay-as-you-go model, making exceptional decisions during crises, strategically using IS, considering ERP sys-

tem alignment, and conducting sensitivity analysis for disaster-tolerant services. These practices can enable effective accounting and budgeting while optimizing the utilization of AWS services within large organizations.

Chapter 3

Literature Review

3.1 Overview of knowledge management tools

The APO's Knowledge Management Tools and Techniques (KMT&T) has been influential in expanding information access and evolving KM approaches ("Knowledge Management: Tools and Techniques Manual," 2020) [1]. Practitioners and experts have reviewed knowledge management methods, emphasizing the need for successful KM solutions (Kidd, 2005)[15]. Furthermore, the use of information technology in knowledge management has been criticized, emphasizing the significance of choosing appropriate tools (Bjrnson & Dingsyr, 2008) [4].

Knowledge management tools play an important role in supporting innovation and addressing knowledge problems in software organizations. Holland and Dawson proposed a classification of tools based on their effectiveness in solving different knowledge problems, emphasizing the need for a more targeted approach to tool selection (Holland & Dawson, 2010)[11]. Furthermore, the impact of knowledge management technologies on organizational culture has been investigated, with findings indicating that organizational culture has a major influence on information sharing and learning inside the organization (Rabelo et al., 2015)[21].

Integration of information technology with knowledge management has been a research emphasis, with studies highlighting the relevance of IT tools such as cloud computing, big data, and social media in enabling successful knowledge management in businesses (Cupia et al., 2018)[7]. Furthermore, the relationship between information technology and knowledge management competence has been investigated, with an emphasis on knowledge management capability's mediating function in improving organizational performance (Sukardi, 2019)[26].

The use of knowledge management tools, such as blog platforms, in the context of education has been recommended to improve instructors' knowledge management and satisfy the different needs of learners (Xiao-hui, 2008)[28]. Furthermore, the impact of knowledge management tools in boosting personal knowledge and adaptation has been explored in university student e-knowledge management models under blended learning (Qian & Liu, 2013)[20].

Overall, knowledge management tool selection and implementation are crucial for solving specific knowledge problems, stimulating innovation, and improving organizational performance. The integration of information technology with knowledge management, as well as the impact of corporate culture on knowledge sharing, highlight the importance of utilizing proper technologies to efficiently manage knowledge assets.

3.2 Relevance to oral history and *Laboratorio di Storia Orale*

While most of the literature currently in publication focuses on knowledge management in various organizational contexts, the lessons and ideas gained from these studies can be strategically tailored to meet the particular challenges and goals of *Laboratorio di Storia Orale*. This makes the application of Knowledge Management Tools and Techniques (KMT&T) in the field of oral history preservation particularly significant.

The recording and conservation of oral histories pose a unique set of challenges that frequently involve a variety of media formats, including text, images, audio, and video. The APO's Knowledge Management Tools and Techniques Manual (2020)[1] emphasizes the significance of knowledge management as a means of enhancing access to information, which is consistent with *Laboratorio di Storia Orale*'s mission to guarantee the thorough conservation of oral histories for posterity.

Successful knowledge management solutions have been emphasized by practitioners and experts, as noted by Kidd (2005)[15]. Given the complexity of oral history, *Laboratorio di Storia Orale* must carefully choose and apply knowledge management tools because doing so will support the organization's mission to record, organize, and disseminate the rich tapestry of oral narratives.

Understanding the socio-cultural dynamics inherent in oral history preservation is important, as demonstrated by Rabelo et al. (2015)[21]'s exploration of the impact of knowledge management technologies on organizational culture.

Holland and Dawson's (2010)[11] classification of knowledge management tools based on their effectiveness in solving different knowledge problems can inform *Laboratorio di Storia Orale*'s tool selection, ensuring a targeted approach to address the unique challenges posed by oral history archiving.

As evidenced by the research conducted by Cupia et al. (2018)[7] and Sukardi (2019)[26], the combination of information technology and knowledge management is in line with the current state of digital preservation. The literature has highlighted the use of technologies like social media, cloud computing, and big data as creative ways for *Laboratorio di Storia Orale* to improve its archival and knowledge management procedures.

Xiao-hui (2008)[28] suggests that knowledge management tools be used in the educational context to enhance the pedagogical aspects of *Laboratorio di Storia Orale*'s initiatives. Qian and Liu (2013)[20] conducted research on knowledge management tools in university student e-knowledge management models, which offers insights into modifying such tools for academic settings.

Finally, the synthesis of insights from various studies emphasizes the significance of tailored tool selection, acknowledging the unique nature of oral narratives and the broader socio-cultural and technological landscape in which *Laboratorio di Storia Orale* operates. In summary, the relevance of knowledge management tools to *Laboratorio di Storia Orale* lies in their potential to address the unique challenges of oral history preservation.

3.3 Existing solutions and gaps in the literature

Many studies have examined the application of knowledge management tools in organizational settings, with an emphasis on improving information access, fostering collaboration, and fostering innovation. Notable examples of these tools include the APO's Knowledge Management Tools and Techniques (KMT&T) Manual (2020)[1] and methodologies proposed by experts such as Holland and Dawson (2010)[11]. The literature on knowledge management tools reveals a diverse array of solutions implemented across various domains.

The solutions that are currently in place for the preservation of oral histories have frequently been modified from general knowledge management practices. Examples of these solutions include content management systems, database systems, and multimedia archives. The use of these tools has made it easier to store, retrieve, and distribute oral histories, but it has also brought to light some particular difficulties that are specific to oral histories.

3.3.1 Gaps in the Literature

Even while the body of current literature offers insightful information, there are still a number of gaps and restrictions, which presents an opportunity for additional study and creativity:

3.3.1.1 Adaptation to Oral History Requirements

There is a need for solutions specifically tailored to the diverse media types, narrative structures, and cultural sensitivities inherent in oral history archives because many of the knowledge management tools currently in use are generic in nature and may not adequately address the nuanced requirements of oral history preservation.

3.3.1.2 Interdisciplinary Collaboration

There are not many thorough studies that connect knowledge management with fields like history, anthropology, and cultural studies in the literature. To create solutions that truly capture the holistic nature of oral narratives, information management professionals must work in tandem with domain-specific scholars.

3.3.1.3 User-Friendly Admin Interfaces

The user experience is not always given priority by current tools, especially when it comes to administrators who oversee the archive. Improving the admin interfaces' usability—making them simple to use and effective—is essential to the adoption of knowledge management tools in companies such as *Laboratorio di Storia Orale*.

3.3.1.4 Integration of Emerging Technologies

Although research indicates that information technology has a significant impact on knowledge management, little is known about how cutting-edge technologies like artificial intelligence, machine learning, and natural language processing can be combined to improve oral history content curation, classification, and accessibility.

3.3.1.5 Ethical and Legal Considerations

The literature frequently skimps on discussing the moral and legal implications of preserving oral histories; there are knowledge gaps on consent, privacy, and intellectual property rights, all of which are critical when working with delicate and culturally relevant narratives.

3.3.2 Addressing Gaps in the Current Research

With the development of a knowledge management tool customized to the particular requirements of *Laboratorio di Storia Orale*, we hope to provide a comprehensive solution that takes into account the particular challenges posed by the preservation of oral history and integrates technological advancements while adhering to ethical and legal considerations. This research project aims to fill these identified gaps in the body of knowledge.

3.4 Methodology

3.4.1 Research Design

To accomplish the research aims, a mixed-methods technique that combines qualitative and quantitative research methodologies was used. The comprehensive approach sought to provide a nuanced understanding of the current challenges in oral history preservation, the features that a knowledge management tool must have, and the impact that the developed tool will have on the archival practices of *Laboratorio di Storia Orale*.

3.4.1.1 Qualitative Phase

In order to obtain insights into best practices and potential challenges, the qualitative phase involved consulting with experts in knowledge management, oral history, and information technology in addition to conducting a thorough review of the literature on knowledge management tools that had already been published with an emphasis on their application in oral history preservation.

3.4.1.2 Quantitative Phase

The quantitative phase concentrated on gathering information to guide the design and development of the knowledge management tool. To identify specific needs and preferences, surveys were given to administrators, historians, and end users at *Laboratorio di Storia Orale*. The information gathered was then analyzed to produce quantitative insights that shaped the tool's feature set.

3.4.2 Tool Development

A multidisciplinary team comprising Mohammad Latifi as a software developer, Marco Orlandi as technical support with university IT infrastructure and hosting, and supervision of Prof. Novello as domain-specific expert for history worked together to develop the knowledge management tool, which was designed to be modular and scalable and incorporate features that were identified during the qualitative and quantitative phases of the project.

3.4.2.1 Selection of Technologies

The technologies that were chosen were chosen after a careful analysis of the various tools and platforms that were available. Scalability, dependability, and compatibility with the unique requirements of *Laboratorio di Storia Orale* led to the integration of AWS S3 for audio storage and Lambda functions for dynamic content retrieval.

3.4.2.2 User-Centered Design

User-centered design was the development process's guiding principle. Knowledge management tool prototypes were tested iteratively with stakeholders to make sure the user interface was intuitive and satisfied the wide range of needs from administrators to end users. The tool's functionality and interface were refined based on feedback from these sessions.

3.4.2.3 Integration of Multimedia Formats

The tool was created to accommodate a variety of media types, such as text, audio, video, and photographs, in order to address the heterogeneous character of oral history content. By integrating different formats, the tool was intended to offer a comprehensive solution for archiving a wide range of project data.

3.4.3 Implementation and Testing

The knowledge management tool that was developed was put into use in *Laboratorio di Storia Orale*'s operational environment. A thorough evaluation of the tool's functionality, performance, and user experience was carried out through a combination of simulated usage scenarios, stress testing, and end-user feedback sessions.

3.4.4 Evaluation

During the evaluation phase, the knowledge management tool's ability to achieve its goals was evaluated. Important performance metrics, including the effectiveness of content retrieval, user satisfaction, and the effect on archival practices, were measured and analyzed. The outcomes were compared to the original goals and utilized to further improve the tool.

3.4.4.1 User Feedback

User feedback, including questionnaires and feedback sessions, was crucial in helping to improve the tool. Administrators and historians at *Laboratorio di Storia Orale* provided valuable insights into the program's overall influence on their workflow as well as its usability and usefulness.

3.4.4.2 Performance Metrics

The tool's performance was evaluated through the monitoring of quantitative indicators such as reaction times, storage efficiency, and system reliability; any departures from the anticipated benchmarks prompted additional research and improvement.

3.4.5 Ethical Considerations

Ethical concerns were of utmost importance throughout the whole research and development process. All participants in surveys and user testing provided informed consent, and privacy and data protection precautions were put in place, especially regarding the sensitive nature of oral history content.

3.4.6 Limitations

Although great care was taken to develop a comprehensive knowledge management tool, there are still some drawbacks. These include the possibility of a learning curve for administrators who are not familiar with digital tools, the continual advancement of technology, and the constant need to adjust to new requirements.

3.4.7 Conclusion

This study's methodology ensured a methodical and comprehensive approach.

Chapter 4

Description of the Development Process

This chapter provides an in-depth overview of the development process for the *Laboratorio di Storia Orale* project. It covers the stages of planning, development, testing, and deployment, shedding light on the technologies selected and the rationale behind their adoption. The primary focus is on the Laravel framework, which serves as the backbone of the application, facilitating the integration of various technologies to achieve project objectives.

4.1 Technologies Used

The development process of the *Laboratorio di Storia Orale* project involved the strategic selection of technologies to manage oral history data effectively. The choices were driven by the necessity for robust, scalable solutions capable of handling multimedia content while ensuring user-friendly access for researchers and participants.

4.1.1 Digital Audio Recording Tools

Cutting-edge digital audio recording tools were employed for capturing high-quality oral histories. The tools were chosen based on their reliability, audio clarity, and user-friendly interfaces, ensuring a seamless experience for both interviewers and interviewees.

4.1.2 Transcription and Annotation Software

AI-enabled transcription software was utilized to efficiently transcribe audio files. The software also featured annotation functions, facilitating rich metadata tagging for detailed analysis and enhanced searchability.

4.2 CMS Software

The project utilized a customized Content Management System (CMS) as the core platform for organizing and archiving oral history interviews within the Laravel framework. This CMS offered an intuitive interface, enabling users to upload, categorize, and access the extensive database of recorded histories.

4.2.1 Content Upload and Management Modules

Integrated into the Laravel-based CMS were modules for content upload and management, ensuring secure and structured storage of oral histories. These modules supported various data formats and prioritized user accessibility.

4.2.2 Search and Retrieval Functions

The CMS incorporated advanced search and retrieval functions, allowing efficient navigation through a vast volume of oral histories. Machine learning algorithms enhanced these functions, improving search results over time.

4.3 Integration of AWS S3 and Lambda Function for Audio Management

To ensure robust and scalable cloud storage, the project integrated Amazon Web Services (AWS), leveraging AWS S3 for storing audio files and Lambda functions for audio processing within the Laravel framework.

4.3.1 AWS S3 Implementation for Audio Storage

AWS S3, chosen for its high durability and availability, guaranteed the safety and accessibility of audio data. The S3 implementation was optimized for handling the large multimedia files typical of oral history projects.

4.3.2 Serverless Processing with AWS Lambda

AWS Lambda's serverless computing environment was employed to transcode audio files and extract automatic metadata. This approach provided a cost-effective and scalable solution, accommodating the project's varying computational demands seamlessly.

4.4 System Architecture

The system architecture was meticulously designed within the Laravel framework, emphasizing modularity, security, and performance.

4.4.1 Microservices-based Backend

Adopting a microservices-based approach for the backend allowed independent scaling and updating of different services. This architecture enhanced resilience and facilitated rapid iteration during the development phase.

4.4.2 Frontend-Backend Decoupling

Decoupling the system's frontend from the backend services within the Laravel framework promoted development flexibility and ease of maintenance. This architectural choice also improved the system's ability to efficiently serve a diverse range of client devices.

This chapter sets the stage for the subsequent exploration of PHP frameworks in the next chapter, delving into their historical evolution and the impact on the *Laboratorio di Storia Orale* project.

Chapter 5

Evolution of PHP Frameworks

5.1 Introduction

In the ever-evolving landscape of web development, the emergence of frameworks has played a pivotal role in shaping the way applications are built and maintained. This chapter explores the history of PHP frameworks, their evolution over time, and their significance in terms of security, speed of development, and ease of maintenance.

5.2 Early Days of PHP Development

PHP, initially created by Rasmus Lerdorf in 1994, started as a set of Common Gateway Interface (CGI) binaries written in C. It was a simple tool for managing personal websites. As web development needs grew, developers sought ways to organize code and promote reusability.

5.3 First Generation PHP Frameworks

The late 1990s and early 2000s saw the emergence of the first-generation PHP frameworks, such as CakePHP and Zend Framework. These frameworks aimed to bring structure to PHP development by introducing concepts like model-view-controller (MVC) architecture.

5.4 Security Concerns in Early PHP Development

Early PHP projects often faced security challenges due to the lack of standardized practices. Frameworks started addressing these concerns by providing built-in security features, input validation, and protection against common vulnerabilities.

5.5 Rise of Laravel and Modern PHP Frameworks

The mid-2010s witnessed the rise of Laravel, a modern PHP framework known for its elegant syntax, developer-friendly tools, and robust features. Laravel, along with Symfony, CodeIgniter, and others, ushered in a new era of PHP development, emphasizing convention over configuration.

5.6 Security Advancements in Modern PHP Frameworks

Modern PHP frameworks prioritize security with features like Cross-Site Scripting (XSS) protection, Cross-Site Request Forgery (CSRF) tokens, and secure defaults. They encourage best practices such as parameterized queries and password hashing to enhance application security.

5.7 Speed of Development and Ease of Maintenance

Frameworks significantly accelerate development by providing boilerplate code, libraries, and tools for common tasks. They also contribute to the ease of maintenance by enforcing coding standards, promoting modularization, and facilitating updates and bug fixes.

5.8 Conclusion

The history of PHP frameworks reflects the continuous evolution of web development practices. From addressing security concerns to enhancing speed of development and ease of maintenance, frameworks have become indispensable tools in the PHP ecosystem. As demonstrated in the following chapters, the choice of

Laravel and the integration of AWS services in our project exemplify the benefits of leveraging modern PHP frameworks for building robust and secure web applications.

Chapter 6

Implementation

This chapter provides a comprehensive overview of the implementation process, focusing on the development of the admin panel, front-end integration, challenges faced, and solutions devised, as well as the user interface design considerations.

6.1 Admin Panel Development

6.1.1 Intuitive Design for Non-Technical Administrators

Recognizing that administrators of the website may not necessarily be tech-savvy, special attention was given to crafting an admin panel with an intuitive and user-friendly design. The objective was to ensure ease of use, allowing administrators to navigate and manage the platform effortlessly.

6.1.2 Steady Admin Sidebar

To enhance usability, the admin sidebar was implemented as a consistent and steady component throughout the admin panel. This design choice allows administrators to access different sections of the panel seamlessly, maintaining a familiar and navigable experience.

6.1.3 Entity-based Project Creation

The admin panel facilitates the creation of projects by breaking down the process into smaller, manageable entities. Administrators can easily construct projects by

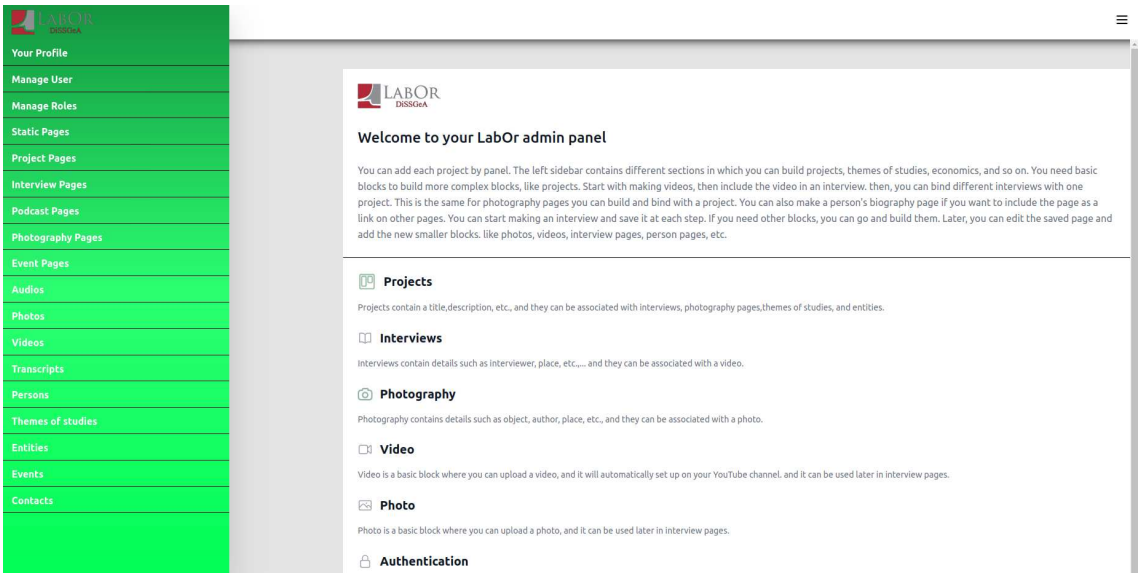

Figure 6.1: *admin panel*

building individual blocks, whether they be text, images, videos, or other content types. The modular approach allows for flexibility in project creation and modification.

6.1.4 CRUD Operations for All Entities

The admin panel empowers administrators with complete control over content through comprehensive CRUD (Create, Read, Update, Delete) operations for all entities. This means administrators can create, edit, delete, and manage projects, text blocks, image blocks, video blocks, and other entities effortlessly. As an example, we can see the next figure for the video part in the admin panel:

6.1.5 User Role Management

In consideration of collaboration within the oral history lab, the admin panel includes user role management functionality. New contributors can be added, and the 'admin' role can be assigned to grant them privileges for site administration. This feature enables students and other collaborators to contribute to the administration of the site.

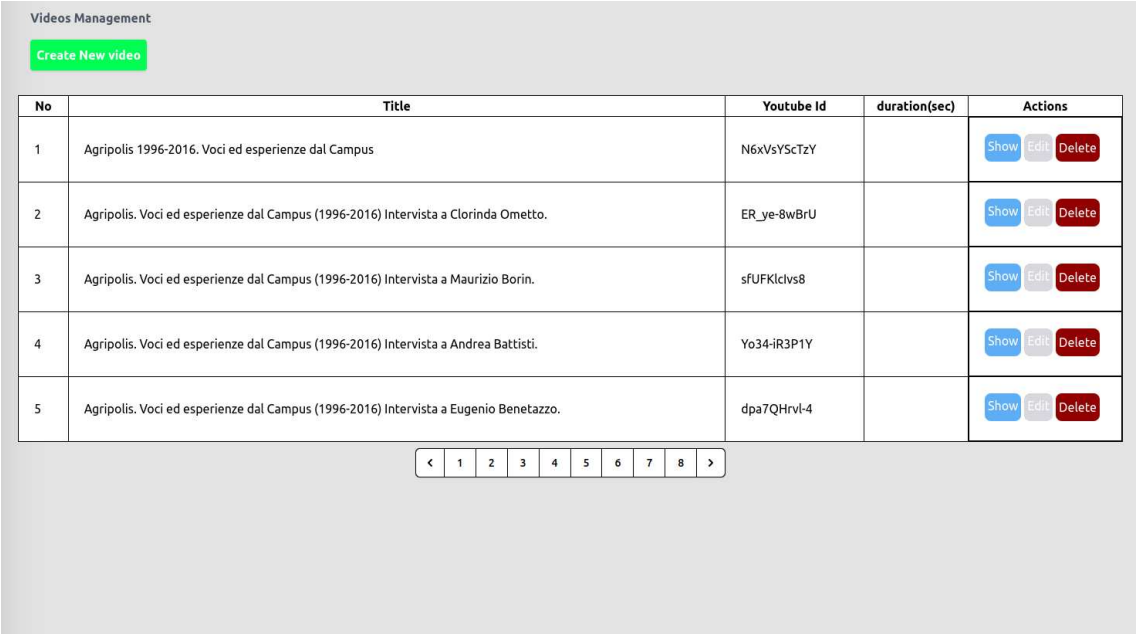

Figure 6.2: *video part in the admin panel*

6.2 Front-end Integration

6.2.1 Responsive Design for Public-Facing Interface

The front-end of the site, where visitors interact, is designed with a responsive approach. This ensures that the website provides an optimal viewing and interaction experience across a wide range of devices, including desktops, tablets, and smartphones.

6.2.2 Seamless Visitor Experience

The front-end integration focuses on providing a seamless user experience aligned with the principles of responsive design. The goal is to ensure that the website is accessible and functions smoothly across various devices and screen sizes.

6.2.3 Project Building Blocks Display

The user interface prominently displays the building blocks of projects, such as images, videos, and text, making it straightforward for administrators to visual-

ize and organize their content. This approach facilitates efficient project creation and management.

6.3 Challenges Faced and Solutions

6.3.1 Integration of AWS Services

The integration of AWS S3 for audio storage and Lambda functions for audio processing presented challenges in terms of implementation and configuration. Solutions involved meticulous debugging, consultation of AWS documentation, and collaboration with the development community to optimize the integration for performance and reliability.

6.3.2 User Permission Model

Designing and implementing a flexible user permission model posed challenges in balancing security and usability. Solutions included iterative refinement of the role-based access control system, user feedback sessions, and thorough testing to ensure the proper functioning of user roles and permissions.

6.4 User Interface

6.4.1 Project-centric Interface

The user interface prioritizes a project-centric design, allowing administrators to focus on the construction and management of individual projects. Clear visual cues and an organized layout contribute to an efficient and enjoyable user experience.

6.4.2 Dynamic Content Creation

To facilitate dynamic content creation, the user interface provides a user-friendly environment for adding, editing, and arranging project components. The drag-and-drop functionality enhances ease of use, enabling administrators to customize projects with minimal effort.

This chapter delves into the intricacies of the implementation process, highlighting the thoughtful design choices made to create a user-friendly admin panel

and front-end integration. The subsequent chapters will explore the outcomes and impact of these implementation decisions.

6.5 Public User Interface

The development of a user-friendly and accessible Public User Interface (UI) stands as a pivotal aspect of our endeavor to create an engaging and seamless online experience. Through the meticulous implementation of `Tailwind CSS`[1], our primary goal was to craft a cross-browser responsive UI that not only caters to diverse user preferences but also facilitates intuitive navigation throughout our website.

`Tailwind CSS`, known for its utility-first approach, enabled us to streamline the UI development process by providing a robust set of pre-defined styles and components. Leveraging this framework, we meticulously designed the UI to be responsive across various devices and browsers, ensuring a consistent and optimal user experience regardless of the platform being used. The emphasis on

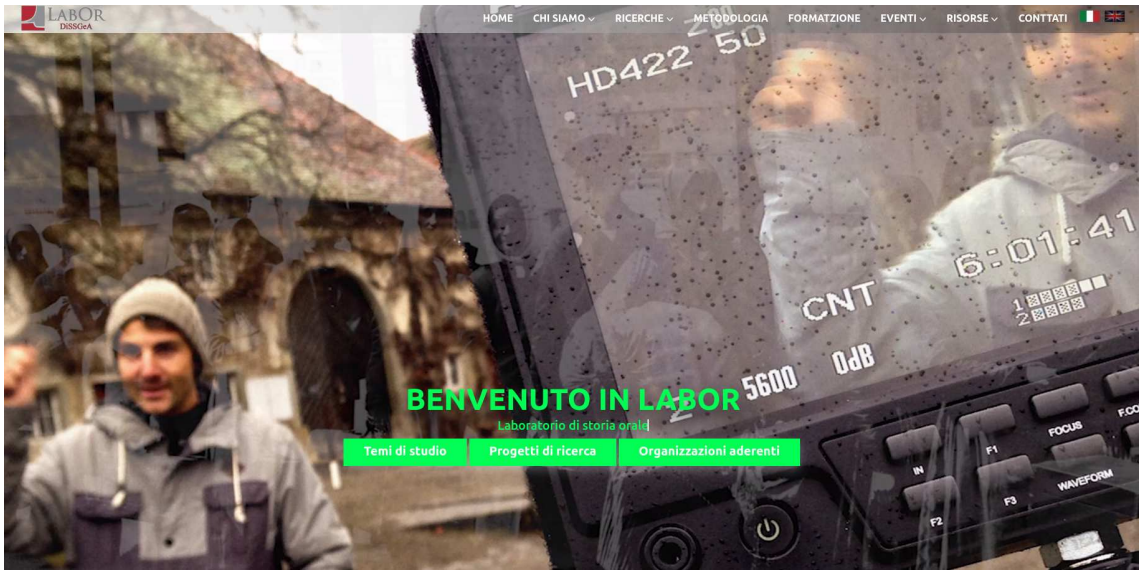

Figure 6.3: *public user interface*

cross-browser compatibility is paramount in our design philosophy. By adhering to web standards and leveraging `Tailwind CSS` features, we aimed to mitigate

[1]https://tailwindcss.com/

potential discrepancies in rendering across different browsers. This approach not only enhances the user experience but also contributes to the inclusivity of our platform, accommodating a broad spectrum of users with varying browser preferences.

Furthermore, our UI design prioritizes clarity and simplicity to assist users in navigating the website effortlessly. Through strategic use of color schemes, typography, and layout, we aimed to create an aesthetically pleasing interface that not only aligns with our brand identity but also guides users intuitively through the various sections and functionalities of the platform.

In essence, our `Tailwind CSS`-powered Public User Interface is a testament to our commitment to user-centric design. By incorporating responsive and cross-browser compatible elements, we strive to provide an accessible and enjoyable experience for all users, fostering a digital environment where information is easily accessible and interactions are seamlessly facilitated.

Chapter 7

AI-powered Transcription of Audio Files with AWS Integration

7.1 Introduction

Transcribing audio files into text is a critical task in many applications, from generating subtitles for videos to indexing spoken content for search. With the rise of AI technologies, automatic transcription has become more accurate and efficient. In this chapter, we will explore the integration of AWS services for automating the transcription process in a Laravel application. To achieve this, we will use Serverless development as a bridge between our Laravel application and AWS AI services like AWS transcribe.

7.2 benefits of Serverless Development: AWS Lambda Functions

The benefits of serverless development, such as AWS Lambda functions, are numerous and can significantly ease the development and maintenance processes for organizations. Serverless computing platforms, like AWS Lambda, offer benefits such as simplified operational management, automatic scaling, reduced infrastructure management, and cost-efficiency (Baldini et al., 2017)[3]. These platforms allow developers to focus solely on writing and deploying code without the need to provision or manage servers, leading to increased development speed and agility (Smolander, 2018)[12]. Additionally, the pay-as-you-go model of serverless computing can result in cost savings, as organizations only pay for the

actual compute time used, making it an attractive option for many applications (Kettunen Mäkitalo, 2019)[14].

Furthermore, serverless computing can simplify the DevOps process by automating operational tasks, making it easier to manage and maintain applications (Smolander, 2018)[12]. The use of serverless computing also offers benefits for specific use cases such as event processing, API composition, data flow control, and more, making it a versatile solution for a wide range of applications (Jiang et al., 2021)[13]. Additionally, serverless platforms like AWS Lambda provide built-in fault tolerance and high availability, reducing the burden on developers for ensuring the reliability of their applications (Borges et al., 2021)[5].

Moreover, the ease of development and maintenance is further enhanced by the ability to leverage intra-function parallelism, which can lead to significant cost savings and improved performance for serverless workloads (Kiener et al., 2021)[16]. The serverless model also allows for rapid scaling, making it well-suited for handling fluctuating workloads and sudden increases in demand without manual intervention (Ristov et al., 2022).[23] Additionally, the serverless paradigm can be extended to various domains, such as IoT systems, quantum computing, and multimedia processing, further showcasing its versatility and applicability (Elkholy Marzok, 2022[8]; , Nguyen et al., 2022[18]; , Risco Moltó, 2021[22]).

In conclusion, the benefits of serverless development, particularly AWS Lambda functions, are extensive and can greatly ease the development and maintenance processes for organizations. From simplified operational management and automatic scaling to cost-efficiency and versatility across various domains, serverless computing offers a compelling solution for modern application development and maintenance.

7.3 Workflow Overview

The workflow begins with an admin uploading an audio file through the Laravel app to an S3 bucket. A Lambda function is triggered on the upload of the audio file and passes it to the AWS Transcribe service. The output file, a JSON transcription file, is stored back in the S3 bucket. Another Lambda function is triggered to notify the Laravel app of the new JSON transcription file in the S3 bucket. The Laravel app then converts the content of the JSON file to a PDF file and stores it on the on-premises host, adding details to the file table in its database.

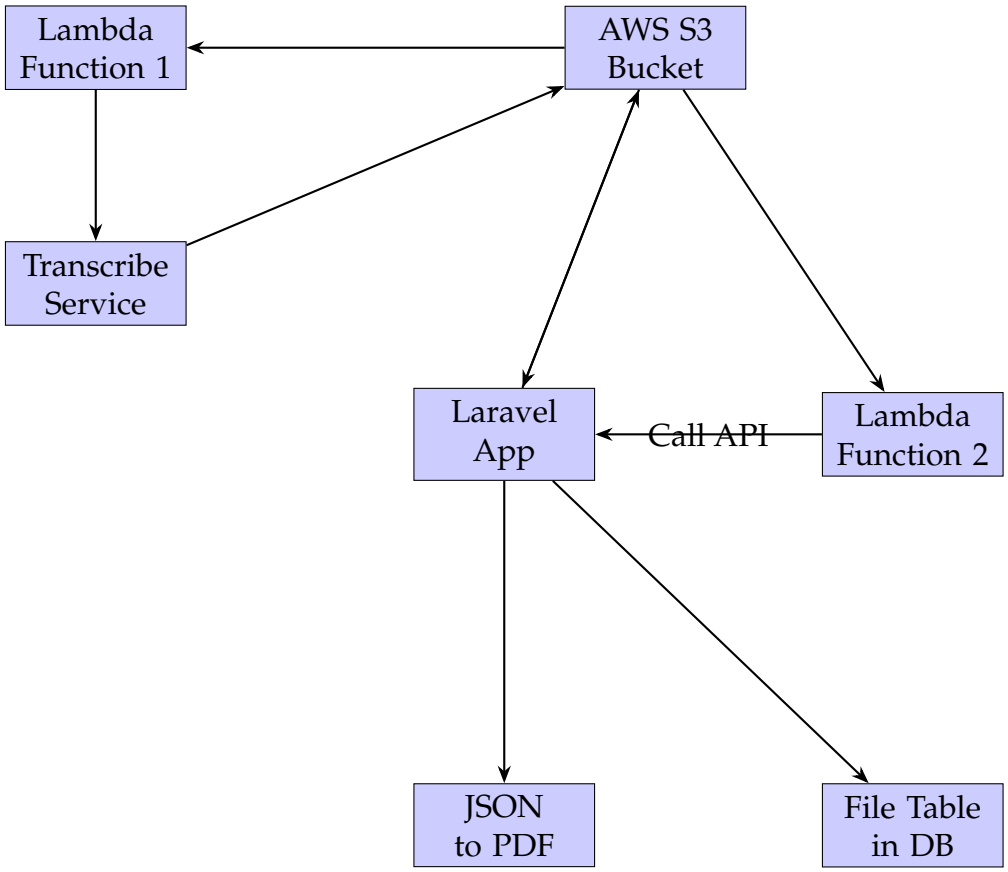

Figure 7.1: *Architecture Diagram for AI-powered Transcription with AWS Integration*

7.4 Implementation Details

7.4.1 Laravel App

The Laravel app serves as the interface for the admin to upload audio files to the S3 bucket. It also handles the conversion of the JSON transcription file to a PDF file and the storage of metadata in the database.

7.4.2 AWS S3 Bucket

The S3 bucket is used for storing both the uploaded audio files and the JSON transcription files generated by the AWS Transcribe service.

7.4.3 AWS Lambda Functions

The Lambda functions are responsible for triggering the transcribe service and notifying the Laravel app of new transcription files in the S3 bucket. They act as the glue between the different components of the workflow.

7.4.4 AWS Transcribe Service

The Transcribe service is utilized for converting the audio files to text, producing the JSON transcription files that will be further processed by the Laravel app.

7.5 Conclusion

The integration of AWS services with the Laravel app enables an efficient and automated transcription workflow. With the power of AI and cloud computing, the process of transcribing audio files is streamlined, demonstrating the potential for AI-powered transcription in various real-world applications.

Chapter 8

YouTube API for Video archiving

8.1 Utilizing the YouTube API for Video Storage and Display

The decision to leverage the YouTube API for storing and displaying videos in the context of this project is driven by a multitude of advantages that not only streamline the video management process but also enhance user experience and optimize resource utilization. This section discusses the various reasons behind choosing the YouTube API and the associated benefits.

8.1.1 Cost-Effective Video Storage

One of the foremost advantages of using the YouTube API is the cost-effective storage solution it offers. Storing videos on YouTube incurs no direct payment for storage, allowing the project to minimize infrastructure costs associated with maintaining a dedicated video storage solution. This cost-effectiveness is particularly advantageous for projects with budget constraints, as it enables the allocation of resources to other critical aspects of development.

8.1.2 Exposure to a Wider Audience

By integrating the YouTube API for video storage, the project gains immediate access to YouTube's vast user base. This exposure to a global audience enhances the visibility of the videos, contributing to increased reach and engagement. Leveraging the popularity of YouTube as a content-sharing platform ensures that the

videos have the potential to reach a broader audience compared to a standalone solution.

8.1.3 Improved SEO and Discoverability

Utilizing YouTube for video hosting positively impacts search engine optimization (SEO). YouTube is a highly indexed platform, and videos hosted on it are more likely to appear in search engine results. This improved visibility enhances the discoverability of the videos, leading to increased organic traffic. The project benefits not only from the inherent SEO strength of YouTube but also from the potential for videos to be recommended to users based on their preferences and viewing history.

8.1.4 Simplified Management with Video IDs

The integration of the YouTube API simplifies video management to a great extent. Storing videos on YouTube involves associating each video with a unique identifier (ID). In the project's database, only the video IDs need to be stored, making the management process straightforward. Retrieving and displaying videos to users becomes a simple task of embedding YouTube iframes with the respective video IDs, reducing the complexity of the system.

8.1.5 Risk Mitigation for Data Loss

Another significant advantage of relying on the YouTube API is the inherent data redundancy and risk mitigation for data loss. YouTube, as a platform, employs robust backup and redundancy measures, reducing the likelihood of video data loss. In contrast to maintaining an independent video storage infrastructure, which might be susceptible to hardware failures or data corruption, leveraging YouTube minimizes the risk of losing valuable video content.

8.1.6 Efficient Video Streaming

YouTube is optimized for efficient video streaming, offering adaptive bitrate streaming and automatic video transcoding. This ensures that users experience smooth playback regardless of their device or internet connection. By utilizing YouTube's infrastructure, the project can provide a high-quality streaming experience without the need for extensive backend optimization efforts.

In conclusion, the decision to use the YouTube API for video storage and display is a strategic choice driven by a combination of cost-effectiveness, exposure to a wider audience, improved SEO, simplified management, risk mitigation, and efficient video streaming. This approach aligns with the project's goals of optimizing resource utilization, enhancing user experience, and ensuring the long-term accessibility and discoverability of video content.

Chapter 9

Summary of findings

9.1 Contributions to the Field

This research project has made significant contributions to the field of knowledge management, particularly in the development of a hybrid deployment model that seamlessly integrates with powerful AI tools provided by AWS. The primary emphasis has been on breaking down limitations associated with on-premises hosting, allowing for a more dynamic and scalable approach to knowledge management.

9.1.1 Hybrid Deployment for Enhanced Flexibility

One of the primary contributions lies in the adoption of a hybrid deployment model. By utilizing both on-premises infrastructure and cloud services, the knowledge management tools developed in this project achieve a level of flexibility that transcends the constraints of a purely on-premises solution. This hybrid approach ensures that the system remains adaptable to varying workloads and resource demands. It also allows for the efficient utilization of existing on-premises resources while leveraging the scalability and reliability of cloud-based services.

9.1.2 Integration with AWS AI Tools

A pivotal breakthrough in this research project is the successful integration of the knowledge management tools with powerful AI services offered by Amazon Web Services (AWS). This integration extends the capabilities of the system far beyond what would be feasible with solely on-premises hosting. Leveraging AWS AI

tools, such as Textract for text extraction and Polly for text-to-speech conversion, enhances the overall functionality of the knowledge management system.

9.1.3 Breaking Limitations and Paving the Way for Future Innovations

The hybrid deployment not only addresses current needs but also anticipates and breaks limitations that could hinder the scalability and extensibility of the knowledge management system. In a purely on-premises scenario, the integration with cutting-edge AI services may be impractical for a single project due to the associated costs and resource requirements. The hybrid model adopted in this project paves the way for future innovations by making it feasible to explore and incorporate additional AI services without the burden of significant infrastructure investments.

9.1.4 Scalability and Cost-Effectiveness

Furthermore, the hybrid deployment model contributes to the system's scalability and cost-effectiveness. It allows for the dynamic allocation of resources based on demand, optimizing both performance and cost. This approach ensures that the knowledge management tools can adapt to varying workloads efficiently, promoting sustainability and avoiding unnecessary expenditures.

9.1.5 Enabling Future Exploration of AI Services

An essential aspect of this contribution is the foresight it provides for the future development of the knowledge management system. With the hybrid deployment and integration with AWS AI tools, the system is well-positioned to explore and incorporate additional powerful AI services as they become available. This forward-thinking approach opens the door to continual improvement and innovation in the field of knowledge management.

In summary, the hybrid deployment model, coupled with the integration of AWS AI tools, stands as a groundbreaking contribution to the field of knowledge management. By breaking down limitations and paving the way for future innovations, this research project has established a foundation for the continued enhancement and evolution of knowledge management systems in the era of cloud computing and artificial intelligence.

9.2 Future work and recommendations

In addition to the current functionality of the Laravel application, there are exciting possibilities for further development and enhancement. Two potential avenues for future work are outlined below, each with a suggested architecture leveraging AWS services.

9.2.1 Archiving Digital Copies of Historic Books or Hand-writings

One compelling direction for future development is the archival of digital copies of historic books or hand-writings. This can be achieved through a systematic process involving image recognition and text extraction. The proposed architecture is as follows:

- Users upload scanned images of each page of a document through the Laravel application.
- The images are stored in an AWS S3 bucket.
- An AWS Lambda function is triggered upon image upload, which processes each image using the Amazon Textract service to extract text.
- The extracted text is stored in a JSON file in another AWS S3 bucket.
- A subsequent Lambda function is invoked to call the Laravel application, which retrieves the JSON file from the S3 bucket and writes the text data into the database as pages of the document.

This systematic approach automates the process of digitizing historical documents, making them easily accessible and searchable.

9.2.2 Text-to-Speech Conversion Using AWS Polly

Another avenue for future development involves enhancing accessibility by incorporating text-to-speech conversion. AWS Polly can be leveraged to convert the extracted text into voice, providing an auditory experience for users. The proposed architecture is as follows:

- An event binding is set up to trigger a Lambda function whenever a JSON file is added to a specific directory in the S3 bucket containing text.

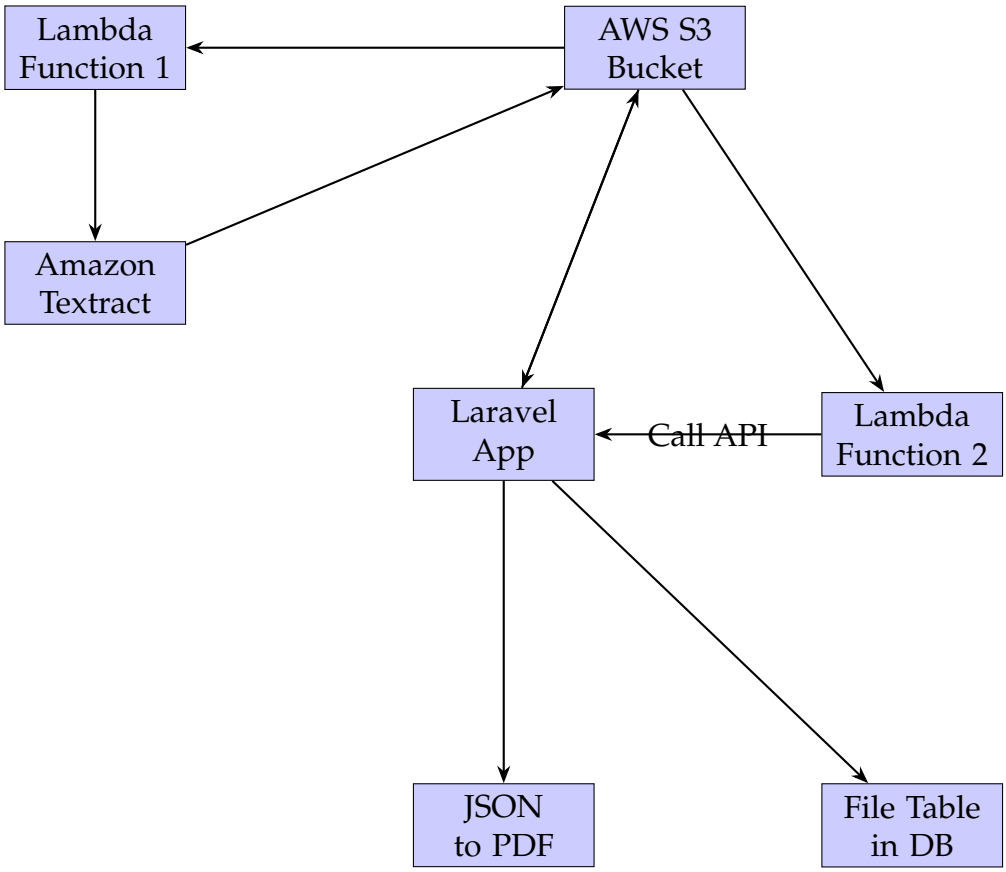

Figure 9.1: *Architecture Diagram for image recognition and text extraction*

- The Lambda function reads the JSON file and passes the text to the AWS Polly service for text-to-speech conversion.
- Once the audio file is generated and stored in the S3 bucket, another Lambda function is triggered to call the Laravel application.
- The Laravel application receives essential data such as the name and path of the audio file and incorporates this information into the database.

This feature enriches the user experience by providing an alternative means of accessing information through auditory channels.

These proposed developments not only expand the capabilities of the current Laravel application but also contribute to the broader goals of digital preservation and enhanced user accessibility.

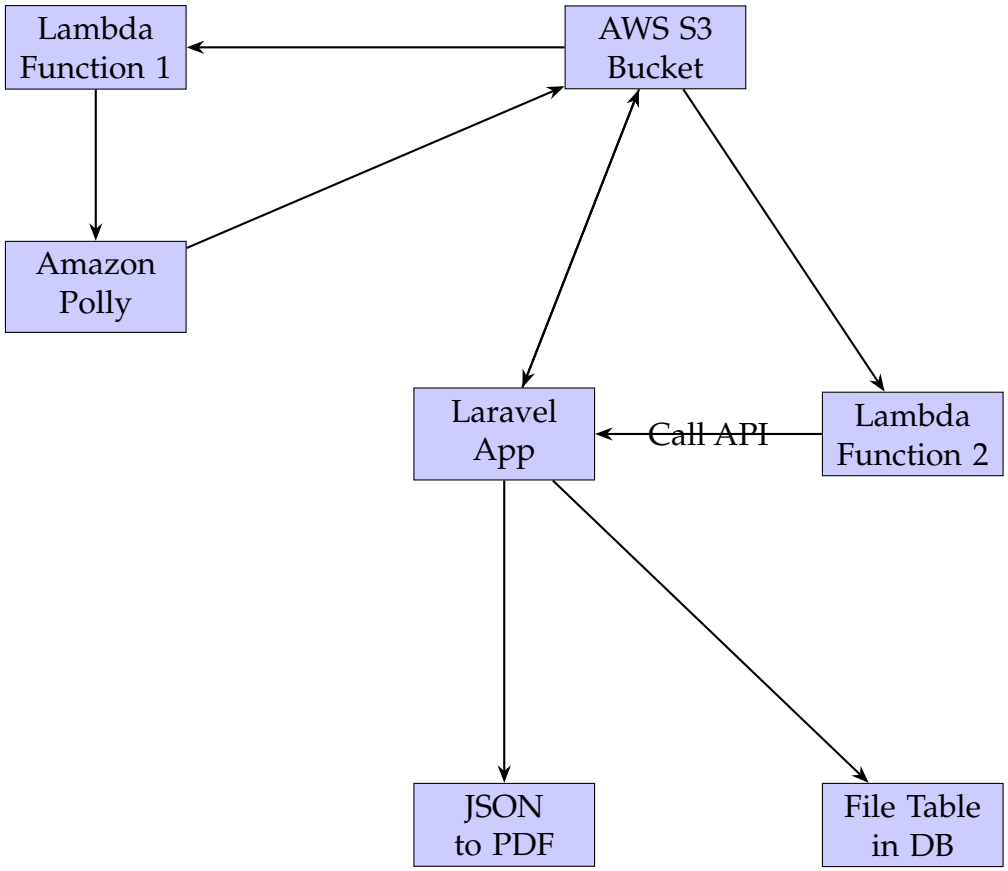

Figure 9.2: *Architecture Diagram for Text-to-Speech Conversion Using AWS Polly*

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